

A SIX-TRANSISTOR 2-WAVE POCKET SUPERHET

PRACTICAL 1/3

AUGUST
1958

EDITOR: F.J. CAMM

WIRELESS



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SERVICING RADIO RECEIVERS

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A BEGINNER'S CONSTRUCTIONAL COURSE

TRANSMITTING TOPICS

AN ELECTRONIC FLASH UNIT

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CERAMICS

for all electronic applications

Silvered Ceramic Condensers cover a variety of useful shapes, including Pearls, Discs, Beads and Tubes, and have many applications in R.F. circuits — particularly where ultra-high frequencies are present, when their low inductance and excellent power factor are of special advantage. A wide choice of negative and positive temperature co-efficients permits the temperature compensation of other components, and frequency stabilisation of tuned circuits.

Hi-K CERAMIC DISCS

for decoupling purposes in T.V. and spark suppression in small electrical apparatus—extremely low inductances. Up to 10,000 pF at 500 v. D.C. working. Finished in a moisture-resisting compound that does not soften or crack up to 100°C.

LOW-K TUBULARS

with the choice of four temperature co-efficients and a wide range of capacity values, serve many purposes in general circuitry.

Hi-K TUBULARS

combine high capacity with small physical size: used widely as by-pass condensers in T.V. and other H.F. receivers where low inductance is of special value.

LOW-K PEARLS

of up to 10 pF capacity and

LOW-K DISCS of up to 50 pF. with high negative temperature co-efficient permitting compensation of other components and frequency stabilisation in tuned circuits.



THE TELEGRAPH CONDENSER CO. LTD

RADIO DIVISION: NORTH ACTON • LONDON • W.3 • Telephone: ACORN 0061

AN OUTSTANDING NEW HI FI SPEAKER



Stentorian H.F.1016

- 10" Die-cast Chassis
- 16,000 gauss magnet
- 10 watts handling capacity
- Patented Stentorian Cambric Cone
- Universal Impedance Speech Coil
(instantaneous matching at 3, 7.5 and 15 ohms)
- 30-15,000 c.p.s. frequency response
- 35 c.p.s. bass resonance

£8 (inc. P.T.)

Incorporates a very powerful magnet assembly, which combines with the cambric cone to provide brilliant transient response when the speaker is mounted in a bass reflex cabinet. It may be used with the new T.359 Cone Tweeter Unit (or the well-known T.10) as an outstanding two-speaker system at very low cost.

T.359 Cone Tweeter Unit.
Speech coil impedance, 5 or 15 ohms.
Response, 3,000 to 17,000 c.p.s.
Price: 35/- (inc. P.T.)



Hear it at all leading Hi Fi dealers; write our London office (109 Kingsway, W.C.2) for name of nearest stockist, and leaflets on all W.B. products. The complete range is demonstrated at this address every Saturday, 9 a.m. to 12 noon.



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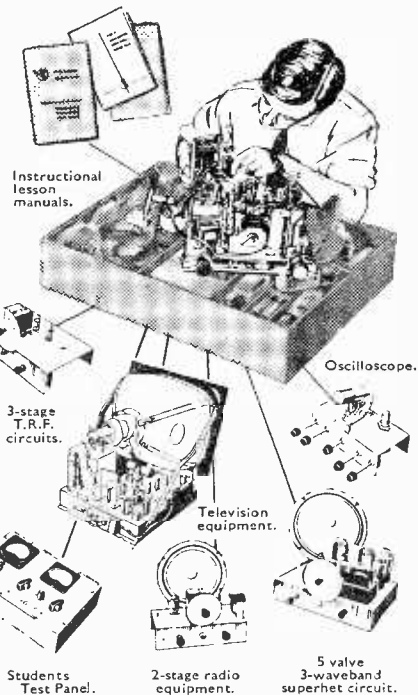
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NEW — completely up-to-date methods of giving instruction in a wide range of technical subjects specially designed and arranged for self-study at home under the skilled guidance of our teaching staff.

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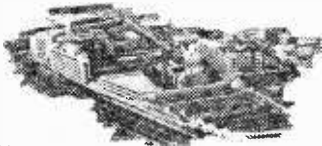
Radio and television courses, with which specially prepared components are supplied, teach the basic electronic circuits (amplifiers, oscillators, detectors, etc.) and lead, by easy stages, to the complete design and servicing of modern Radio and T/V equipments.

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AUG./58

The only Home Study College run by a World-wide industrial organisation

R.S.C. BATTERY CHARGING EQUIPMENT

ASSEMBLED CHARGERS

6 v. 1 amp.	19/9
6 v. or 12 v. 1 amp.	27/9
6 v. 2 amps.	29/9
6 v. or 12 v. 2 amps.	38/9
6 v. or 12 v. 4 amps.	56/9

Above ready for use. Carr. 3/6. With mains and output leads.

SELENIUM RECTIFIERS F.W. BRIDGE TYPES

6/12 v. 1a.	4/11	L.T. Types H.W.
6/12 v. 2a.	9/9	2-6 v. 1a. H.W.
6/12 v. 3a.	11/9	H.T. Types H.W.
6/12 v. 4a.	14/9	150 v. 40 mA. 3/9
6/12 v. 6a.	19/9	250 v. 50 mA. 5/9
6/12 v. 10a.	25/9	250 v. 89 mA. 7/9
6/12 v. 15a.	35/9	250 v. 250 mA. 11/9

BATTERY CHARGER KITS

Consisting of Mains Transformer, F.W. Bridge, Metal Rectifier, well ventilated steel case, Fuses, Fuse-holders, Grommets, panels and circuit. Carr. 2/9 extra.

6 v. or 12 v. 1 amp.	32/9
6 v. 2 amps.	25/9
6 v. or 12 v. 2 amps.	31/6
6 v. or 12 v. 4 amps.	53/9

BATTERY CHARGER KIT

Consisting of F.W. Bridge Rectifier, 6/12 v. 5 a. Mains Trans. 0-0-15 v. 6 a. output and Ammeter. 49/9. Post 3/9.

ASSEMBLED CHARGER

6 v. or 12 v. 2 amps.

Fitted Ammeter and selector plug for 6 v. or 12 v. Louvred metal case, finished attractive hammer blue. Ready for use. With mains and output leads. Double Fused. Only Carr. 3/9

49/9

All for A.C. Mains 200-250 v., 50 cc. s. Guaranteed 12 months.

Assembled 6 v. or 12 v. 4 amps.



Fitted Ammeter and variable charge rate selector. Also selector plug for 6 v. or 12 v. charging. Louvred steel case with etched blue hammer finish. Fused 7/5- and ready for use with mains and output leads. Carr. 4/6. Credit Terms: Deposit 30- and 4 monthly payments, 13/-.

R.S.C. MAINS TRANSFORMERS (GUARANTEED)

Interleaved and Impregnated. Primaries 200-230-250 v. 50 cc. s. Screened.

TOP SHROUDED DROP THROUGH

250-0-250 v. 70 mA	6.3 v. 2a. 5 v. 2a.	16/9
350-0-350 v. 80 mA	6.3 v. 2a. 5 v. 2a.	18/9
250-0-250 v. 100 mA	6.3 v. 4a. 5 v. 3a.	23/9
300-0-300 v. 100 mA	6.3 v. 4a. 5 v. 3a.	23/9
350-0-350 v. 100 mA	6.3 v. 4a. 5 v. 3a.	23/9
350-0-350 v. 100 mA	6.3 v. 4v. 4a. C.T.	23/9
0-4-5 v. 3a.		23/9
350-0-350 v. 150 mA	6.3 v. 4a. 5 v. 3a.	29/9

FULLY SHROUDED UPRIGHT

250-0-250 v. 60 mA	6.3 v. 2a. 5 v. 2a.	
Midget type 21-3-3in.		
250-0-250 v. 100 mA	6.3 v. 4a. 5 v. 3a.	17/9
250-0-250 v. 100 mA	6.3 v. 6a. 5 v. 3a.	26/9
for R1355 conversion		
300-0-300 v. 100 mA	6.3 v. 4a. 5 v. 3a.	26/9
350-0-350 v. 100 mA	6.3 v. 4a. 5 v. 3a.	26/9
300-0-300 v. 120 mA	6.3 v. 4a. 6.3 v. 1a.	
for Mullard 510 Amplifier		
350-0-350 v. 150 mA	6.3 v. 4a. 5 v. 3a.	33/9
350-0-350 v. 150 mA	6.3 v. 2a. 6.3 v. 2a. 5 v. 3a.	35/9
425-0-425 v. 100 mA	6.3 v. 4a. C.T.	35/9
6.3 v. 2a. C.T.	5 v. 3a. Suitable Williamson Amplifier, etc.	49/9

FILAMENT TRANSFORMERS

All with 200-250 v. 50 c.s. primaries 6.3 v. 1.5 a. 5/9; 6.3 v. 2a. 7/6; 0-4-6.3 v. 2a. 7/9; 12 v. 1a. 7/11; 6.3 v. 3a. 9/11; 6.3 v. 6a. 17/6; 12 v. 3a. or 24 v. 1.5a. 17/6.

JUNCTION TRANSISTORS

Brand new R.F. type 17/6. A.F. 7/6.

VOLUME CONTROLS

with long (in. diam.) spindle all values less switch, 2/9; with S.P. switch, 3/9; with D.P. switch, 4/6.

EX-GOVT. SMOOTHING CHOKES

250 mA. 20 H 200 ohms	19/9
250 mA. 5 H 50 ohms	12/9
150 mA. 10 H 100 ohms	11/9
150 mA. C-10 H 150 ohms	8/9
120 mA. 12 H 100 ohms	9/9
100 mA. 5 H 100 ohms	3/11

CHARGER TRANSFORMERS

All with 200-230-250 v. 50 c.s. Primaries: 0-9-15 v. 1; a 11/9; 0-9-15 v. 3a. 16/9; 0-9-15 v. 5a. 19/9; 0-9-15 v. 6a. 23/9.

SMOOTHING CHOKES

250 mA. 5 H 100 ohms	12/9
150 mA. 7-10 H 200 ohms	11/9
100 mA. 10 H 200 ohms	8/9
80 mA. 10 H 350 ohms	5/9
60 mA. 10 H 400 ohms	4/11

OUTPUT TRANSFORMERS

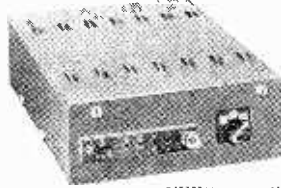
Midget Battery Pentode 6C1 for 3S4, etc.	3/9
Small Pentode, 5,000 Ω to 3 Ω	3/9
Small Pentode 7,000 Ω to 3 Ω	3/9
Standard Pentode 5,000 Ω to 3 Ω	4/9
Standard Pentode, 7,000 Ω to 3 Ω	4/9
10,000 Ω to 3 Ω	4/9
Push-Pull 10-12 watts 6V6 to 3 Ω or 15 Ω	15/9
Push-Pull 10-12 watts to match 6V6 to 3-5-9 or 15 Ω	16/9
Push-Pull EL84 to 3 Ω or 15 Ω	16/9
Push-Pull 15-18 watt, 6L6, KT66	22/9
Push-Pull 20 watts, sectionally wound 6L6, KT66, etc., to 3 Ω or 15 Ω	47/9

ELIMINATOR TRANSFORMERS

Primaries 200-250 v. 50 c.s.	
123 v. 40 mA. 5-0-5 v. 1a	15/9
90 v. 15 mA. 4-0-4 v. 500 mA	9/9

R.S.C. BATTERY TO MAINS CONVERSION UNITS

Type BM1. An all-dry battery eliminator. Size 5 1/2 x 4 1/2 x 2 1/2 in. approx. Completely replaces batteries supplying 1.4 v. and 90 v. where A.C. mains 200-250 v. 50 c.s. is available. Suitable for all battery portable receivers requiring 1.4 v. and 90 v. This includes latest low consumption types.



Type BM2. Size 8 1/2 x 5 1/2 x 2 1/2 in. Supplies 120 v. 50 v. and 60 v., 40 mA. and 2 v. 0.4 a. to 1 amp. fully smoothed. Thereby completely replacing both H.T. batteries and L.T. 2 v. accumulators. When connected to A.C. mains supply 200-250 v. 50 cc. s. **SUITABLE FOR ALL BATTERY RECEIVERS** normally using 2 v. accumulator. Complete kit of parts with diagrams and instructions, 49/9, or ready for use, 59/6.

Complete kit with diagrams, 39/9, or ready to use 46/9.

A.M.F.M. RADIOGRAMS. Brand new cartoned. Made by well-known manufacturer. Fitted 3-speed autochanger with hi-fi turnover pick-up; 4 wavebands, 2 Medium, Long and V.H.F. Attractive polished walnut-finished cabinet. For 200-250 v. A.C. mains. Only 29/9 rns., or £6.18.6. deposit and 9 monthly payments of 3 rns.

HEADPHONES. Brand new. Low resistance. Only 6/9 pr.

TANNOY RE-ENTRANT 8 WATT SPEAKERS. 27/6 ea.

INSTRUMENT KNOBS. Black, 1 1/2 in. dia. Standard type, 1- ea. 9- doz. 80/- Cross.

BRAND NEW LUCAS MOTOR CYCLE BATTERIES. 6 v. 22 a.h. in sealed cartons. Only 39/6, carr. 4/6.

EXTENSION SPEAKERS

Ready for use in walnut veneered cabinet. 6in. 2-3 ohms. 29/11. 8in. 2-3 ohms. 35/9. Very limited number



EX-GOVT. METAL BLOCK (PAPER) CONDENSERS

4 mfd. 350 v., 2.9	4 mfd. 1,000 v., 4.9
8 mfd. 500 v., 4.9	10 mfd. 500 v., 3/9

MAINS TRANSFORMERS

Manufacturers' surplus. Primaries 200-250 v. 50 cc.s. 375-0-375 v. 150 mA. 6.3 v. 4 a. C.T. 8.3 v. 1 a. Fully shrouded, 22/9. 325-0-325 v. 100 mA. 6.3 v. 2.5 a. 5 v. 2 a. Drop through type, 18/9. Postage on either type 2/9.

THE SKYFOUR T.F. RECEIVER.

A design of a 3-valve Long and Medium wave 200-250 v. A.C. Mains receiver with selenium rectifier. It consists of a high gain H.F. stage and low distortion anode bend detector. Power pentode output is used. Valve line-up 6KT, 5Y2, 6V6G. Selectivity and quality are well up to standard, and simplicity of construction is a special feature. Point-to-point wiring diagrams, instructions and part lists, 1/9. Maximum output 5 watts. £4.18.6. including attractive Brown or Cream Bakelite or Walnut veneered wood cabinet 12 x 6 1/2 x 5 1/2 in.

EX-GOVT. DOUBLE WOUND 'STEP UP/STEP DOWN' TRANSFORMERS:

10-0-100-200-240 v. to 5-0-5-115-135 v. or REVERSE. 400 watts. Only 12/9. Plus 2/9 post. 10-0-100-200-220-240 v. to 9-0-112-136-148 v. or REVERSE. 200 watts. 35/9. plus 7/6 carr. Both 50 c.p.s.

EX-GOVT. MAINS TRANSFORMER

Primary 0-110-120-200-210-220-230-240-250 v. 50 c.p.s. Secs. 275-0-275 v. 100 mA. 6.3 v. 7a. 5 v. 3a. Govt. rating, 29/9. Following with 230-250 v. primaries: 400-0-400 v. 200 mA. 5 v. 3a. 5 v. 2a. 19/9; 230-0-230 v. 100 mA. 12.6 v. 1.5 a. 5 v. 2a. 11/9; 12.5 v. 3a. 5 v. 3a. 9/9. Postage 2/9 on any type.

EX-GOVT. CASES.

Size 14-10-8 1/2 in. High. Well ventilated. Black crackle finished, undrilled cover. Suitable for BATTERY CHARGER OR INSTRUMENT CASE. OR COVER COULD BE USED FOR AMPLIFIER. Only 9/9, plus 2/9 postage. Size 8 1/2 x 13 1/2 x 5 1/2 ins. with undrilled well ventilated cover finished in stoved grey enamel. Suitable for charger or instrument case, 7/9, plus 2/9 post.

EX-GOVT. VALVES (NEW)

1R5	7/9	6J5	5/9	ECC91	4/9
1T1	7/9	6J6	4/9	EF90	7/9
1S5	7/9	6V6G	7/9	EB91	4/9
3S4	8/9	6X4	6/9	EF71	8/9
5Y3G	8/9	6X5GT	9/9	EL32	3/9
5U4G	8/9	6L6G	11/9	KT44	4/9
5Z4C	9/9	807	7/9	KT61	9/9
6K7G	5/9	12A6	7/9	EZ90	6/9
6S7GT	6/9	15D2	4/9	EL84	10/9
6SL6T	8/9	35Z4GT	8/9	MU12 14	9/9
6SN7GT	8/9	4H4	4/9	PW50	9/9
6AT6	7/9	ECC83	9/9	SP61	2/9

SPECIAL OFFERS: Electrolytics.

150 mfd. 450 v., 3/9. Small .0005 mfd. 2-gang. 4/9 ea. Westinghouse Rectifiers 250 v. 250 mA. 7/9.

CO-AXIAL CABLE.

75 ohm 1/2 in. 8d. v. Twin-Screened Feeder 11d. yd.

ELECTROLYTICS (current production), NOT EX-GOVT.

Tabular Types	Can Types
8uF 450 v. ... 1/9	16 mfd. 350 v. ... 1/11
8 mfd. 500 v. ... 2/6	16uF 450 v. ... 2/9
16uF 350 v. ... 2/3	32uF 350 v. ... 2/11
16uF 450 v. ... 2/9	32 mfd. 450 v. ... 4/9
32uF 500 v. ... 3/9	100 mfd. 450 v. ... 4/9
25uF 25 v. ... 1/3	8-16uF 450 v. ... 2/11
50uF 12 v. ... 1/3	8-16uF 450 v. ... 3/11
50 mfd. 25 v. ... 1/6	16-16uF 450 v. ... 4/9
50uF 50 v. ... 1/9	32-32uF 350 v. ... 4/9
100 mfd. 12 v. ... 1/9	32-32uF 450 v. ... 5/9
100 mfd. 25 v. ... 2/3	100-100 mfd. 350v. 5-9
1,500 mfd. 6 v. ... 1/6	100-200 mfd. ... 1/2
3,000 mfd. 6 v. ... 3/9	275 v. ... 6/2

R.S.C. A8 ULTRA LINEAR 12 WATT AMPLIFIER

High-Fidelity Push-Pull Amplifier with "Built-in" Tone Control. Pre-amp. stages. High sensitivity. Includes 5 valves (807 outputs). High Quality sectionally wound output transformer, specially designed for Ultra Linear operation, and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS, AND TREBLE "Lift" and "Cut". Frequency response ± 3 db. 30-30,000 c/s. Six negative feedback loops. Hum level 71 db. down. ONLY 70 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and practically all microphones. Comparable with the very best designs.

£7-15-0

For STANDARD or LONG - PLAYING RECORDS. For MUSICAL INSTRUMENTS such as STRING BASS, GUITARS, etc. OUTPUT SOCKET with plug provides 300 v. 20 mA. and 6.3 v. 1.5 a. For supply of a RADIO FEEDER UNIT. Size approx. 12-9" in. For A.C. mains 200-250 v. c/s. Outputs for 3 and 15 ohm speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Unapproachable value at £7/15/- or factory built 45/- extra. Carriage 10/-.

If required louvred metal cover with 2

COLIARO RC54 3-SPEED AUTO-CHANGERS with Studio pick-up. Brand new. For 110 v. 50 c.p.s. A.C. mains. Price with 110 v. to 200-250 v. Auto Trans. only £8.19.6. Carr. 5/6.

COLIARO CONQUEST 4-SPEED AUTO-CHANGERS with high fidelity Studio Pick-up. Latest model. Brand new. Cartoned. For 200-250 v. 50 c.p.s. A.C. mains. Our price £29/19.6. Carr. 5/6. Credit Terms. Deposit 3 gn., and 6 monthly payments of 21/6.

COLIARO 4-SPEED SINGLE PLAYER with separate pick-up, as fitted RC457. For 200-250 v. A.C. mains. 4 grs. Post 3/9.

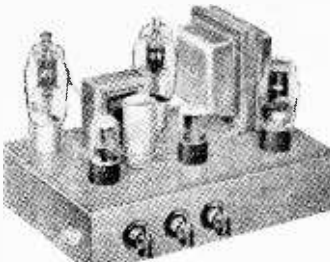
PICK-UP ARMS complete with Hi-Fi turnover critical heads, G.P.54. Limited number brand new, perfect at approx. half price. Only 29/9.

LG3 MINIATURE 2-3 WATT GRAM AMPLIFIER. For use with above or any other single or auto-change units. Output for 2-3 ohm speaker. For 200-250 v. 50 c.p.s. A.C. mains. Overall size 6 1/2 x 4 1/2 in. Controls - Vol. and Tone with switch. Guaranteed 12 months. Only 55/9.

SUPERHET FEEDER UNIT. Design of a high quality Radio Tuner Unit (specially suitable for use with any of our Amplifiers. Delayed A.V.C. employed. The W.Ch. Sw. incorporates Gram position. Controls are Tuning, W.Ch. and Vol. Only 250 v. 15 mA. H.T. and L.T. of 8.3 v. 1 amp. required from amplifier. Size of unit approx. 8-6" in. high. Simple alignment procedure. Point-to-point wiring diagrams, instruction and priced parts list with illustration. 2/6. Total building cost, £4/15/-. For descriptive leaflet send S.A.E.

LINEAR L45 MINIATURE 4.5 WATT QUALITY AMPLIFIER. Suitable for use with Colliaro, B.S.R. or any other record playing unit, and most microphones. Negative feedback 12 db. Separate Bass and Treble Controls. For A.C. mains input of 200-250 v. 50 c/s. Output for 2-3 ohm speaker. Three miniature Mullard valves used. Size of unit only 6-5" in. high. Output for 2-3 ohm speaker. Guaranteed for 12 months. Only £5/19.6. Send S.A.E. for illustrated leaflet. Credit Terms. Deposit £2.6 and 5 monthly payments of 22/6.

LINEAR DIATONIC 10-14 WATT HIGH FIDELITY PUSH-PULL ULTRA LINEAR AMPLIFIER. For 200-250 v. A.C. mains. Valves ECC83, ECC83, EL84, EL84, EZ81 miniature Mullard. Self-contained Pre-amp. Tone Control stage and separate Bass and Treble Controls. Independent "Mike" and Gram input sockets are provided. Output Matchings for 3 and 15 ohm. speakers. Only 12 GNS. ; or Deposit 26.8 plus 10/- carr. and 9 monthly payments of 26/9. Send S.A.E. for leaflet.



carrying handles can be supplied for 19.9. Additional input sockets with associated Vol. control so that two different inputs such as Gram and "Mike" or Tape and Radio can be mixed, can be provided for 13/- extra. Guaranteed 12 months.

TERMS on assembled two input model : DEPOSIT 25/6 and nine monthly payments 25/6.

HIGH-FIDELITY MICROPHONES AND SPEAKERS in stock. Keep cash prices or credit terms if supplied with amplifier.

R.S.C. 4.5 WATT A5 HIGH-GAIN AMPLIFIER

A highly sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high-fidelity pick-up heads, in addition to all other types of pick-ups and practically all "mikes". Separate Bass and Treble Controls are provided. These give full long-playing record equalisation. Hum level is negligible being 71 db. down. 15 db. of negative feedback is used. H.T. of 300 v. 25 mA. and L.T. of 6.3 v. 1.5 a. is suitable for the supply of a Radio Feeder Unit, or Tape-Deck pre-amplifier. For A.C. mains input of 200-250 v. 50 c/s. Output for 2-3 ohm speaker. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate) with Blue hammer finish and point-to-point wiring diagrams and instructions. Exceptional value at only £4/15/- or assembled ready for use 25/- extra, plus 3/6 carr.; or Deposit 22.6 and 5 monthly payments of 22.6 for assembled unit.



LINEAR LT45 HIGH QUALITY TAPE DECK AMPLIFIER. With "built in" power pack and output ready for stage. For Tape Decks Use ONLY with High or Low Impedance. Playback and Erase Heads, such as Lane, Truvox, Aspden, Colliaro, Carr. 7/6. Brennell, etc. For A.C. Mains 200-250 v. 50 c/s. Linear frequency response ± 3 db. 50-11,000 c/s. Negative feedback equalisation. Illustrated leaflet 6d.

SENSATIONAL OFFER STARR GALAXY 4-SPEED MINOR AUTO-CHANGER. A precision manufactured unit with a motor which virtually eliminates "wow" and rumble. Fitted pick-up with dual sapphire tipped stylus. For 200-250 v. A.C. mains. Limited Stock Only Brand new, cartoned. Carr. 10/- Portable cabinet. Starr Changer, LG3 Amplifier, 6 1/2 in. Shaker. 11 GNS. Carr. 7/6.

£4-19-6

TERMS : C.W.O. or C.O.D. No C.O.D. under £1. Post 19 extra under £2 ; 2.9 extra under £5. All goods supplied subject to terms and guarantees as detailed in current catalogue. Open 9 to 5.30 ; Sat. until 1 p.m. Catalogue 6d. Trade list 5d. S.A.E. with all requisites.

R.S.C. 30 WATT ULTRA LINEAR HIGH-FIDELITY AMPLIFIER A10

A highly sensitive Push-Pull high output unit with self-contained Pre-amp. Tone Control Stages. Certified performance figures compare equally with most expensive amplifiers available. Hum level 70 db. down. Frequency response ± 3 db. 30-30,000 c/s. A specially designed sectionally wound ultra linear output transformer is used with 807 output valves. All components are chosen for reliability. Six valves are used, EF86, EF33, ECC83, 807, 807, GZ33. Separate Bass and Treble Controls are provided. Minimum input required for full output is only 12 millivolts so that ANY KIND OF MICROPHONE OR PICK-UP IS SUITABLE. The unit is designed for CLUBS, SCHOOLS, THEATRES, DANCE HALLS or OUTDOOR FUNCTIONS, etc. For use with Electronic ORGAN, GUITAR, STRING BASS, etc. For standard or long-playing records, OUTPUT SOCKET PROVIDES I.T. and H.T. for a RADIO FEEDER UNIT. An extra input with associated voice control is provided so that two separate inputs such as Gram and "Mike" can be mixed. Amplifier operates on 200-250 v. 50 c/s. A.C. Mains and has output for 3 and 15 ohm speakers. Complete kit of parts with fully punched chassis and point-to-point wiring diagrams and instructions. If required cover as for A8 can be supplied, factory built with 12 months' guarantee, for £13.19.6. TERMS : DEPOSIT 36.9 and 9 monthly payments of 31.9.

11 GNS. Carr. 10/-

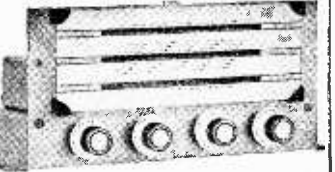
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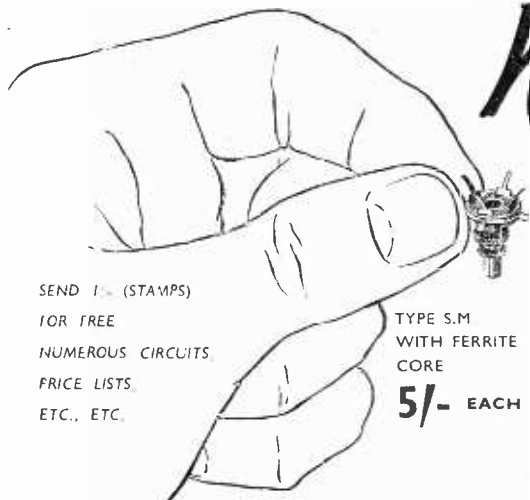
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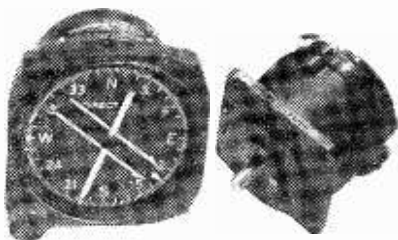
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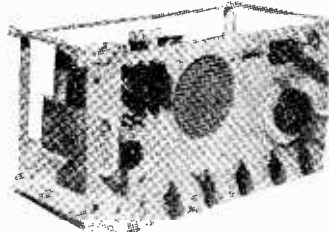
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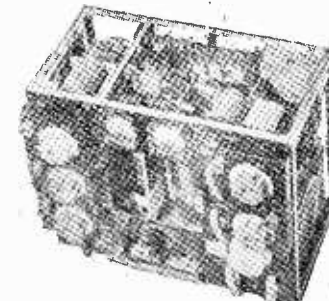


Short Wave Communications Receiver R208. 10/- Down



This is a super short wave receiver covering 5-30 metres (10-60 mc/s). Uses 6 valves. Has R.F. stage, 2 internal power packs, mains and battery vibrator pack. Complete with own P.M. speaker. Provision for phones and speaker muting. Complete in metal transit case; size approx. 24 x 16 x 12; weight 70lb. Suitable A.C. mains, 100-250 and 6 volt battery. In perfect condition, practically unused. Tested before despatch and guaranteed. Handbook free with each. Price £6/19/6, carriage and insurance 15/-.

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W.D. Circuit Details

Diagrams and other information extracted from official manuals. All 1/6 per copy, 12 for 15/- American Service.

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 - B-455-A (or -B)
 - B-454-A (or -B)
 - B-453-M-A (or-B)
 - Transmitter T1154
 - Fifty-eight walkie talkie
 - Frequency meter
 - B.C. 221
- R.109
 - 78 receiver
 - R28/ARC5
 - R1116 A
 - RA-1B
 - AR88D
 - AN/AF-1
 - 78
 - 76
 - R.T.19
 - CAN-36-AAM-
 - RADAR
 - A.S.B-3.
 - Indicator t2A
 - Indicator A.S.B.3
 - Indicator 62
 - Indicator 63K
 - R.F. unit 24
 - R.F. unit 25
 - R.F. unit 26
 - R.F. unit 27
 - Wireless set No. 19
 - Demobbed valves



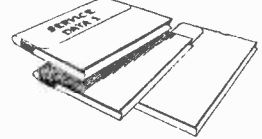
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1T4	7/6	6H6	2/6	7Y4	8/6
1R5	7/6	6J5	5/-	25Y5	10/-
1S5	7/6	6J7	6/-	25Z4	8/6
1T5	8/-	6K6	7/-	25Z6	10/6
2A5	12/6	6L5	9/-	27	10/-
2A6	12/6	6L6	9/-	28D7	3/6
2A7	12/6	6L7	10/6	36	10/-
2X2	4/6	6N7	8/6	39/44	10/-
3A4	7/-	6P8	9/-	41	9/6
3A5	8/-	6Q6	9/-	42	8/-
354	8/-	6Q7	9/-	43	10/-
3V4	9/-	6R7	9/-	57	10/-
5Y3	8/-	6SA7	8/-	58	10/-
5R4	9/6	6SC7	9/-	71	9/6
6U4	8/-	6SH7	6/-	75	12/6
5Z3	15/-	6SJ7	8/6	78	8/6
5Z4	9/6	6SK7	6/-	84	8/6
6A7	12/6	6SL7	8/-	89	12/-
6AR	10/-	6SN7	7/6	807	6/6
6B4	5/-	6SQ7	9/-	1625	10/6
6B	4/-	6SS7	9/-	654	9/6

T.V. Service Sheets



100 sheets covering the most popular post-war Televisors by leading makers—Cosson, Ekco, Ferguson, Pye, etc. £1 post free.

More Summer Sale Bargains

Selenium Rectifier, 36 v. $\frac{1}{2}$ amp. Ideal for trickle charger or for energising model trains, etc. 8.6 plus 2/- & ins.

Cabinet Safety Switch for cutting current as door opens, double pole 15 amp. Also makes food foot-switch. 8/6 plus 2/- p. & i.

Instrument type Slow Motion Drive with engraved scale and locking device. 8/6 plus 2/- p. & i.

Selenium Rectifier rated 26 v. at 6 amp. full wave. Easily rebuilt into four 12-18 v. 3 amp. full wave charging rectifiers. 17/6 plus 2/- p. & i.

Ditto, 500 v. $\frac{1}{2}$ amp., easily rebuilt into full wave or multiple type rectifiers. It contains thirty-one 45 millimetre discs. 10/- plus 2/- p. & i.

Neon Lamp, midjet wire ended. Ideal for making mains tester or for any of the dozen-and-one applications to which a neon can be put. 2/-

Instrument Transformer. Input 200-230 v., output 5.3 v. at 3-4 amp., and two separate 65 v. 10 millamp windings which can be joined in series or parallel, 8/6, plus 1/6 post & packing. 3 in. Meter Moving Coil, flush mounting, really beautifully made by G.E.C. Two types available 300-0-300 microamp and 1 millamp. f.s.d. 37/6 plus 2/- p. & i.

Indicator Lamp for panel mounting, complete with bulb, 2/6.

Fuse Carrier for panel mounting, complete with fuses, 2/6.

Winking Eye, telephone or circuit indicator, 5/-.

Special Purpose Valves
 V.T.10—V.H.F. transmitter, forced aircooled, suitable for H.F. heating, etc., 30/-.

CV.8—Smaller version of above, 20/-.

CV.972—2 separate V.H.F. transmitters coupled together, forced aircooled, £3 per pair.

CV.973—Klystron, £2.

All for less than the price of the cabinet

Fine walnut veneered table receiver cabinet complete with metal chassis, three colour glass scale, back plate and scale mount, as illustrated but less knobs. Offered at less than the price of the cabinet, namely 39/6 plus 5/- carriage and insurance.



Summer Sale Bargains

7 Valve 5 Waveband superhet chassis. H.F. stage and magic eye. Unused but may be slightly soiled and need servicing—less valves, power pack and tuning scale. Contains really fine coil pack which alone would cost twice what we are asking for the whole unit. Price with circuit diagram, £2.15.0. Carriage and insurance 7/6.

4 Valve Superhet Chassis. Long and medium wave complete with valves, but not scale. Unused but slightly soiled and may need servicing (no data available), 29/6, plus insurance 3/6.

10 Valve Superhet. 11 meter ex-Government but unused, complete with valves, easily converted for Band III, 29/6, carriage and packing 7/6.

Isolation Transformer, 150 watt, mains in, isolated mains out, makes servicing safe, 29/6.

Filament Transformer, 6.3 volt 3.4 amps., tapped primary, 8/6.

Transistor Suitable A.F. or low R.F., new tested, O.K. most circuits, 6/6.

Midjet Output Transformer, standard pentode matching, 4/6.

Midjet Output Transformer, Special for battery sets, pentode matching, 4/6.

14in. T.V. Cabinet by famous maker, cost over £4 to make, new and perfect, 15/-, carriage 4/6.

Metal Rectifier, 250 v. 60-80 millamps. Ideal for mains set or instrument or to replace that expensive valve, 4/6.

Constructors Parcel. 5-valve superhet chassis, 15 x 15 x 2 with three waveband glass scale, pulleys, drive head, etc., 9/6, plus post and insurance, 1/6.

Toggle Switch. Standard metal body, type with round dolly, fixing ring and on/off indicating plate, 1/3 of 12/- doz.

For Extra Power Plugs. 7.629 three-core cable, 500 v. grade, 70/- for 100yd. Coil carriage 5/-.

Thin Paxolin Panels. Size 8in. x 5in. 2/6 doz.

Midjet I.F. coils 465 kc/s but with feedback winding for economy circuits, £6 pair.

Mains Transformer. Standard 230 v., input 250-0-250 at 80 ma., 6.3 v. at 5 A, 12/6.

Connecting Wire P.V.C. Covering. All colours. Sale price 2/6 per 100 ft. coil of 5 coils different colours, 10/- the lot.

50 Assorted Resistors. Well mixed and useful values; 1 and $\frac{1}{2}$ watt, 5/- for 50.

Ditto, but 1 watt, 6/6 for 50.

1 mfd 350. Small tubular metal stage condensers made by Dubilier, 2/6 doz.

Loudspeaker 8in. energised field, 9/6, carriage 3/6.

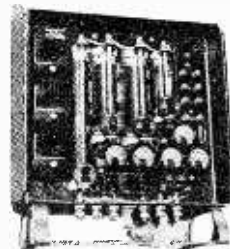
6ft. Unbreakable Mains Lead. Type of lead fitted to electric razors, makes fine lead for test meters and any other devices where subject to continuous bending. Twin figure eight construction, soft cream P.V.C. covered. Normal costs 2/- per yard—we offer the leads for 2/-.

Welding Transformer. 12v-50 amp. continuous rating—intermittent rating for spot welding—exceeds 2,000 amps. 45/-, carriage and packing 5/-.

Metal Rectifier. Equivalent of RM5—250 ma., 250 v., 12/6.

Cathode Ray Tube VCR1517. 7.6, carriage, etc., 3/6.

Thermal Delay Vacuum Relay with book of interesting circuits, 4/6.



Charging Switchboard

Offered at about one-twentieth of original cost. This is an ex-Government switchboard. It contains three reverse current relays, one voltmeter, one main ammeter, two secondary ammeters and three variable resistors for controlling circuits. These are original cases. Price £2 15/-, Carr. 10/-.

Latest AVO Testmeter

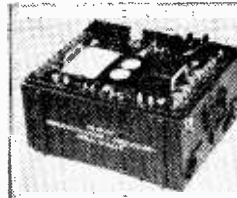


Can be yours for only 10/- deposit and 19 payments of 10/- weekly. Like all AVO meters it is a very fine instrument—it has a sensitivity of 10,000 ohms per volt and 19 most useful ranges as follows—

D.C. volts 0-1,000 (seven ranges). A.C. volts 0-1,000 (five ranges). D.C. current 0-1 amp. (5 ranges), resistance 0-2 meg. (2 ranges) (complete with test leads). Immediate delivery. Cash price £9.10.0.

FREE GIFT.—All purchasers will receive Range Extender scale and data which add capacity 0-1 m.f. in two ranges. Inductance 0-100 henrys, etc., etc.

Telephone Repeater No. 1, Mark 1



This equipment is for amplifying telephone signals in both directions of traffic and also to remedy line distortion of speech. It is intended for use with two wire or four wire circuits, has four amplifiers and is in fact two quite independent repeaters mounted on the same panel and having a common power supply. The power supply may be operated from a 12 volt car battery or from standard A.C. mains. The units are absolutely new in original packing complete with spares and instructional manual. Price £20 each.

Huge Ministry Purchase R.1155—yours for £2 down

Frequency 75 kc/s to 18 Mc/s. 10 valves, metal case, robust receiver, cost over £60 to make—will give years of service, very little used. Price £20 or 5 payments of £2.

Carr. & transit case 15/- et.



This Month's Snip

Miniature motor 2in. long x 1 1/2 in. diameter. 3 in. diameter poles and armature, separate winding for reversing. Operates off 20-30 v. D.C. or off A.C. mains through stepdown transformer. Original cost at least £3 each. Snip price for one month only 6/6, plus 1/6 postage and insurance.



Sapphire Needles

Unrepeatable bargain—new and perfect—two types available: miniature E.M.I. and Standard (trailer). Sale price 1/- each or 10/- doz.



Morganite Potentiometers

Single and 2 gang types available, standard size with good length spindle all new and boxed. Single types 1/- each, values available: 10K, 25K, 50K, 100K, 200K, 500K, 1 meg. 2 meg. Gang type, 3/- each—values available: 5K, 5.5K, 100K+100K, 1 meg. +1 meg.



Yaxley Switches

3-pole, 2-way	1/3
12-pole, 2-way	1/6
3-pole, 3-way	1/6
9-pole, 3-way	2/-
2-pole, 4-way	2/6
6-pole, 4-way	2/6
4-pole, 5-way	2/6
2-pole, 6-way	2/6
1-pole, 7-way	2/6
1-pole, 12-way	2/6
6-position shorting switch	2/-

Double pole, 2-way switch for attaching to Yaxley switches... 1/6

Discount of 10% allowed where a dozen of one type ordered. Special quotes 144 or over.

ELECTRONIC PRECISION EQUIPMENT, LTD

Post orders are dealt with from Eastbourne, so for prompt attention please post your orders to 66, Grove Road, Eastbourne, marked Department 7.

42-46, Windmill Hill, 1/3, Rushing, Midsx. 66, Grove Road, 29, Stroud Green Rd., 266, London Road, Finchbury Park, N.4.1, Croxson, Eastbourne, Sussex. Phone: RUI5LIP 5700. Fax: Bourne, Sussex. Phone: ARChway 1049. Phone: CRO 6558. Half day, Wednesday. Half day, Saturday. Half day, Thursday. Half day, Wednesday.

Stern's "fidelity" TAPE RECORDERS

- THEY INCORPORATE . . .
- Choice of the latest COLLARO or TRUVOX Tape Decks
 - The model HF TR2 "fidelity" AMPLIFIER
 - ROLA CELESTION 10 x 6 in. P.M. Speaker
 - 1,200ft. reel EMI Tape
 - ACOS Crystal Microphone



(Plus £110.0 carriage & insurance of which £1 is refunded on return of Packing Case.)

THIS POPULAR RECORDER IS OFFERED INCORPORATING EITHER . . .

★ THE NEW MK IV COLLARO TRANSCRIBTOR DECK or ★ THE NEW TRUVOX MK IV DECK.

- You WON'T BUY better value
- Truly "Hi-Fi" RECORDINGS are obtainable
- Call in and HEAR THEM or send S.A.E. for ILLUSTRATED LEAFLET

PRICE INCORPORATING COLLARO DECK **£49.10.0**

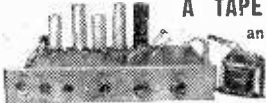
CREDIT SALE Deposit £12.8.0 and 9 Monthly Payments of £4.10.8.

H.P. TERMS. Deposit £24.15.0 and 12 Monthly Payments of £2.5.11.

PRICE WITH TRUVOX DECK INCORPORATING REV. COUNTER . . . **£52.10.0**

CREDIT SALE. Deposit £13.2.6 and 9 Monthly Payments of £4.16.3. H.P. TERMS. Deposit £26.5.0 and 12 Monthly Payments of £2.8.8.

A TAPE PRE-AMPLIFIER and ERASE UNIT



STERN'S MODEL HF/TRIP—A completely assembled Pre-amplifier with

own Power Supply. Can be supplied correctly matched for use with Truvox or Collaro Decks and incorporates Recording Level Indicator and Monitoring facilities. Please send S.A.E. with any enquiry. **PRICE £11.10.0** (Plus 5/- carr. and ins.)

SPECIAL REDUCTION WHEN PURCHASED WITH DECK.

"fidelity" TAPE AMPLIFIER HF/TR2 with Separate SMALL POWER SUPPLY UNIT £16.0.0

(Carr. and ins. 6/-)

H.P. TERMS: Deposit £8 and 9 months of £1. CREDIT TERMS: Deposit £4 and 9 monthly payments of £1.9.4. When ordering please advise make of deck in use. Send S.A.E. for full details.



HOME CONSTRUCTORS. We can supply a COMPLETE KIT OF PARTS to build the TAPE AMPLIFIER for £12 (plus 5/- carr. and ins.). The Assembly Manual, Practical Diagrams, etc., are available for 2/6. {Can be supplied to correctly operate with Collaro & Truvox Decks.}

HOME CONSTRUCTORS

BUILD YOUR OWN RECORDER . . . We offer

(a) The HF/TR2 AMPLIFIER and POWER UNIT, both assembled, with the TRUVOX MK IV TAPE DECK. **£38.10.0**

ALTERNATIVELY the Amplifier and P/ Unit, as a KIT OF PARTS. **£35.0.0**

(b) The HF/TR2 AMPLIFIER and POWER UNIT, both assembled, with the TRUVOX TAPE DECK incorporating PRECISION REV. COUNTER. **£41.10.0**

ALTERNATIVELY the Amplifier and P/ Unit as a KIT OF PARTS. **£38.0.0**

(c) The HF/TR2 AMPLIFIER and POWER UNIT, both assembled, with the NEW MARK IV COLLARO TRANSCRIBTOR DECK. **£36.0.0**

ALTERNATIVELY the Amplifier and P/ Unit as a KIT OF PARTS. **£32.10.0**

plus 12/6 carriage and insurance.

TO COMPLETE THE RECORDER . . . We offer

The Portable Carrying Case . . . Rola 10in. ALL **£9.0.0** (Plus 7/6 carr. & ins.)

X 6in. P.M. SPEAKER . . . 1,200ft. FOR Plastic Tape.

SPECIALY REDUCED PRICES FOR COMBINED ORDERS—ADD TAPE TO YOUR EXISTING AMPLIFIER . . . WE OFFER YOU

(a) The Model HF/TRIP TAPE PRE-AMPLIFIER together with the TRUVOX MK IV TAPE DECK **£35.0.0**

(b) ALTERNATIVELY as in (a) above but Truvox Deck incorporating PRECISION REV. COUNTER **£38.0.0**

(c) The model HF/TRIP TAPE PRE-AMPLIFIER, together with the NEW MK IV COLLARO TRANSCRIBTOR DECK **£32.10.0**

PLEASE INCLUDE 12/6 TO COVER COST of carriage and insurance. HIRE PURCHASE and CREDIT SALE TERMS are available on all equipment (excluding Kits of Parts). Send S.A.E. for details.

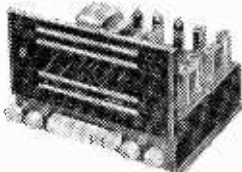
NOTE: The Deck switches of the Transcripator have to be "wired-up." We will complete this wiring for use with either HF/TR2 or the HF/TRIP for an extra £1.

THE NEW COLLARO "TRANSCRIBTOR" MK. IV DECK is in stock at £24.0.0. WE ALSO HAVE A FEW OF THE MK III TRANSCRIBTORS at £17.19.6. (Carriage and Insurance is 10/- extra.)

A Selection of RADIOGRAM CHASSIS enabling "MODERNISATION" of that OLD RADIOGRAM

ALL ARE THE LATEST AM/FM DESIGN

- The Dulci Model H.3 **£20.17.0**
- The Dulci Model H.4 **£24.6.6**
- The Dulci Model H.4/P **£29.2.10**
- The ARMSTRONG 1B 403 **£29.8.0**
- The ARMSTRONG AP 107 **£37.0.0**



We also have the latest FM or combined AM/FM RADIO TUNING UNITS.

- THE Dulci FM Tuner incorporating Power Supply **£17.10.3**
- The Dulci AM/FM Tuning Unit having own Power Supply incorporated **£20.17.0**
- The TSL FM Tuner incorporating Power Supply **£18.18.0**

The above are just a few examples—we have others. Send S.A.E. for full data on any chassis. Credit Sale and H.P. Terms are available.

"FRUSTRATED EXPORT ORDER"

The Cossor Model 527, X 4-Valve "All dry" Battery Transportable.

Offered **£6.15.0** Plus 5/- carr. & ins.

Consists of a 4-valve Superhet Receiver covering Medium Waveband 197-575 metres, and two Short Wavebands 13.9 to 13.9 metres. The new low consumption valves are incorporated and the whole is accommodated in an attractive robustly made case. Battery required is 90 volts and 1.4 volts (price 19/6) and is external to case.

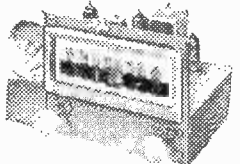
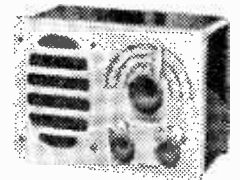
STERN'S "F.M." TUNING UNIT

A 5-valve Tuner incorporating the latest Mullard Permeability Tuning Heart and a "Magic Eye" Tuning Indicator.

PRICE ASSEMBLED **£14.10.0**

READY FOR USE (Plus 7/6 carriage and insurance.)

TERMS: (a) Hire Purchase: Deposit £7.5.0 and 9 monthly payments of 18.4. (b) Credit: Deposit £3.12.6 and 9 monthly payments of £1.6.7.



HOME CONSTRUCTORS—You can build this unit for £10.10.0. Full Assembly Instructions are available for 1/6.

HOME CONSTRUCTORS—BUILD YOUR OWN "HI-FI" LOUDSPEAKER SYSTEM

WITH W-B'S WELL-KNOWN RANGE OF READY-TO-ASSEMBLE CABINETS. ALL ARE BEAUTIFULLY MADE AND FINISHED AND VERY EASILY ASSEMBLED. ONLY A SCREWDRIVER IS REQUIRED. THEY ARE PACKED FLAT IN CARTONS AND COMPLETE WITH SCREWS.

SEND S.A.E. FOR LEAFLET.

STERN RADIO

LIMITED (Dept. P.W.)

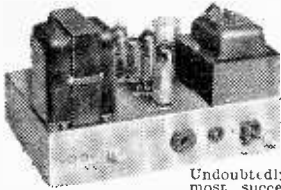
PLEASE SEND S.A.E. WITH ALL

1958 NEW LOOK MULLARD DESIGNS FOR THE "Hi-Fi" ENTHUSIAST

THE VERY POPULAR MULLARD "5-10" MAIN AMPLIFIER

MULLARD'S NEW 2-STAGE PRE-AMPLIFIER - TONE CONTROL UNIT

THE NEW MULLARD "3-3" MAIN AMPLIFIER



Undoubtedly the most successful amplifier yet designed, and used in conjunction with the new Mullard Pre-Amplifier, an undistorted power output of up to 10 watts is obtained. Thoroughly recommended to the "Hi-Fi" enthusiast who contemplates a very high quality home installation. In addition the versatility of the equipment makes it quite suitable for use in small halls, etc. We supply complete to MULLARD'S Specification with specified valves and components and including the latest PARMEKO Ultra-linear Output Transformer and the PARMEKO Mains Transformer which has power available to drive Radio Tuning Unit.

COMPLETE KIT OF PARTS \$10.00
 Alternatively, we supply **ASSEMBLED and TESTED \$11.10** (Carriage & Insurance 5/- extra.)
 This "5-10" with the latest **PARTRIDGE ULTRA-LINEAR OUTPUT TRANSFORMER** for **\$1.60** extra



A completely new design employing Two EPO6 valves, and in particular designed to operate with the Mullard range of Power Amplifiers, but also perfectly suitable for other makes, etc.

- Briefly it incorporates:
- Equalisation for the latest R.I.A.A. Characteristics.
 - Input for variable reluctance.
 - Magnetic Pick-Ups.
 - Input for Crystal Pick-Ups.
 - Input for Tape replay.

- (a) Direct from High Impedance Tape Head.
- (b) From a Tape Amplifier or Pre-Amplifier.

- Sensitive Microphone Channel.
- Wide range Bass and TREBLE Controls.
- Attractive Perspex front control panel.
- Our Kit is strictly to MULLARD'S SPECIFICATION. **\$6.10.0**

COMPLETE KIT OF PARTS
 Alternatively, we supply **ASSEMBLED and TESTED \$8.00** (Carriage & Insurance 5/- extra.)



Laced entirely on the present very popular 3-3 model and designed to operate in conjunction with the new 2-stage PRE-AMPLIFIER (shown left) thus providing all the facilities associated with the more expensive "Hi-Fi" Equipment. We recommend it as the IDEAL HOME INSTALLATION where very high quality is desired at the lower volume level (up to 3 watts). We supply completely to MULLARD'S SPECIFICATION including the latest PARMEKO Output Transformer, specified Valves and Components. Has power available to drive a Radio Tuning Unit. **\$7.0.0**
 Alternatively, we supply **ASSEMBLED and TESTED \$8.0.0** (Carriage & Insurance 5/- extra.)

NOTE Only NEW HIGH GRADE Components and MULLARD VALVES are supplied with these kits—We do NOT use "Surplus or Cheap" components.

Please enclose S.A.E. if ILLUSTRATED and alternatively, the COMPLETE ASSEMBLY MANUALS, containing component Price Lists and Practical Drawings, etc., are available at 1/6 each.

SPECIAL PRICE REDUCTIONS . . .

- (a) THE COMPLETE KIT OF PARTS to build both the "3-3" MAIN AMPLIFIER and the 2-STAGE PRE-AMPLIFIER-CONTROL UNIT **\$12.10.0**
 - (b) THE COMPLETE KIT OF PARTS to build the "5-10" MAIN AMPLIFIER and the 2-STAGE PRE-AMPLIFIER-CONTROL UNIT **\$15.15.0**
- PRICES FOR THE "5-10" ARE SUBJECT TO £1.6.0 EXTRA IF THE PARTRIDGE TRANSFORMER IS REQUIRED.

- (a) The "3-3" and the 2-STAGE PRE-AMPLIFIER both ASSEMBLED and TESTED **\$15.0.0**
 CREDIT: DEPOSIT £3.15.0 & 9 Monthly Payments of £1.7.6 H.P.; DEPOSIT £7.10.0 & 9 Monthly Payments of 19/-.
 - (b) The "5-10" and the 2-STAGE PRE-AMPLIFIER both ASSEMBLED and TESTED **\$18.18.0**
 CREDIT: DEPOSIT £4.15.0 & 9 Monthly Payments of £1.14.7 H.P.; DEPOSIT £9.9.0 & 12 Monthly Payments of 17/6
- When ordering include an extra 7/6 to cover Carriage and Insurance

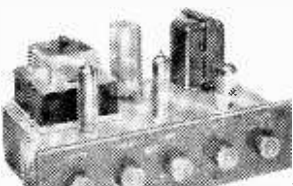
THE NEW COMPLETE MULLARD "5-10" AMPLIFIER



Designed for a simple domestic installation with Genuine High Quality reproduction up to a maximum of 10 watts. Separate BASS and TREBLE Controls are incorporated with switched inputs for 78 and L.P. Records plus Radio Tuning Unit. We incorporate SPECIFIED COMPONENTS and NEW MULLARD VALVES. We also give the purchaser the choice of two of the best ULTRA-LINEAR OUTPUT TRANSFORMERS made—first the latest by PARMEKO LTD., and also the latest by PARTRIDGE (£1.6.0 extra). We also supply the PARMEKO MAINS TRANSFORMER, and this has extra power available to supply a Radio Tuning Unit. The Control Unit can easily be detached from the Amplifier Chassis for use in a remote position.

COMPLETE KIT OF PARTS (PARMEKO Transformer) \$11.10.0
 Alternatively, we supply **ASSEMBLED and TESTED \$13.10.0**
 Credit Sale, Dep. £3.7.6 and 9 Monthly Payments of £1.4.11. H.P. Terms, Dep. £8.15.0 and 8 Monthly Payments of 19/3. Send S.A.E. for ILLUSTRATED LEAFLET for 1/6 for the COMPLETE ASSEMBLY MANUAL.

THE NEW COMPLETE MULLARD "3-3"



A VERY HIGH QUALITY AMPLIFIER PROVIDING EXCELLENT REPRODUCTION AND HAVING AN ATTRACTIVE PERSPEX FRONT PANEL.

COMPLETE KIT OF PARTS \$7.10.0 (plus 6/6 carriage and insurance).
 Alternatively supplied ASSEMBLED and FULLY TESTED **\$8.19.6** (plus 6/6 carriage and insurance).

The complete specification is available for 1/6. Developed from the very regular 3-valve 3-watt Amplifier designed in the Mullard Laboratories. Our kit is complete to MULLARD'S SPECIFICATION including supply of specified components, valves and a PARMEKO OUTPUT TRANSFORMER.

We also include switched inputs for 78 and L.P. records, plus a radio position. Extra power to drive a Radio Tuning Unit is also available.

THE IDEAL AMPLIFIER FOR A SMALL HIGH QUALITY INSTALLATION

The Portable Case will also accommodate almost any make of Autochanger and is attractively finished in Maroon and Grey Roxing.

WE ALSO SUPPLY SEPARATELY—

- (a) The 2-Stage (plus Rectifier) **AMPLIFIER \$4.2.6**
- (b) The PORTABLE CARRYING CASE **\$3.17.8**
- (c) P.M. SPEAKER **19/9**

Carriage and Insurance 4/- extra.

RECORD PLAYERS

The Very Latest Models are in Stock. **MANY AT REDUCED PRICES!!!** TRANSCRIPTION UNITS - AUTO-CHANGERS, SINGLE RECORD PLAYERS

Send S.A.E. for ILLUSTRATED STOCK LIST

A FEW CASH BARGAINS

- The latest HSR 10 X A R C H 4 SPEED "MINOR" AUTO-CHANGER Entirely complete with Crystal Pick Up **\$7.19.6**

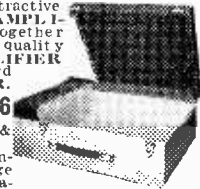


- The latest COLLARO 4 SPEED AUTO-CHANGER Complete with the Studio "O" Pick Up **\$7.19.6** (Also available with the Town gain Studio "P" Pick Up for £8.15.0.)
 - The latest COLLARO 4 SPEED SINGLE RECORD PLAYER complete with Studio "O" Pick Up **\$6.19.6**
 - The COLLARO "JUNIOR" 4 SPEED SINGLE RECORD PLAYER, complete with separate Crystal Pick Up **\$4.10.0**
- (This high output Crystal Pick Up is available separately for £1.12.6.)
 Carriage and Insurance on above Units 5/- ex.

SPECIAL CASH ONLY OFFER !!!

This very attractive PORTABLE AMPLIFIER CASE together with a good quality GRAM AMPLIFIER and a matched P.M. SPEAKER. **ALL FOR \$8.7.6** ONLY (plus 7/6 carr. & ins.).

The Amplifier consists of a 2-Stage design incorporating 3 modern B.V.A. valves and has separate BASS and TREBLE CONTROLS.



109 & 115 FLEET ST., LONDON, E.C.4.
 Telephone: FLect 5812/3/4.
CORRESPONDENCE

Relda guarantee your satisfaction —

PLESSEY SPEAKERS

7in. x 4in. elliptical 3 ohms, 18/6, post paid. 5in. circular, 3 ohms, 17/6, post paid.

MICROPHONES, BRAND NEW. Throat, magnetic, 4/6; Throat, carbon, 3/6; No. 8 carbon with switch, 6/6; No. 7 moving coil, 8/6.

TELEPHONE HANDSET. Brand new 12/6. P. & P. 1/-.

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COMPLETE HEADPHONE AND MICROPHONE ASSEMBLY. A must for every Constructor and "Ham," consists of moving coil, padded headphones and "press to talk" microphone, 10/-, P. & P. 3/6.

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Interleaved and impregnated. Primaries 200-230-250 v. 50 c/s.

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250-0-250 v. 100 mA., 6.3 v. 3.5 a.; 5 v. 2 a.	25/6
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6.3 v. 2.75 a. Filament transformers...	7/6
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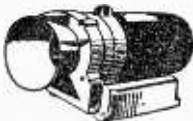
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WALKIE/TALKIE SET

ONLY **60/-** EACH P. & P. 4/-.

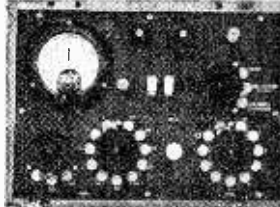


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MAINS TRANSFORMERS

3-way Mounting Type.
MT1
Primary: 200-220-240 v.
Secondaries: 250-0-250 v. 80 m/A 0-6.3 v. 4 amp. 0.4 v. 2 amp. Both tapped at 4 v., 21/9 each.
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Secondaries: 350-0-350 v. 80 m/A 0-6.3 v. 4 amp. 0.5 v. 2 amp. Both tapped at 4 v., 21/9 each.

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Secondary: 30 v. 2 amps.
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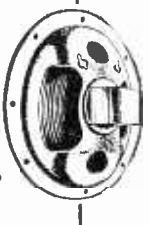
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Lectrona, Plessey	Round	5in.	17/6 each
Goodmans, Plessey	Round	6 1/2in.	18/6 each
Goodmans, R. & A.	Round	8in.	19/6 each
Plessey, R. & A., Elac	Round	10in.	25/6 each
Elac	Elliptical	7in. x 4in.	19/6 each
Elac	Elliptical	10in. x 6in.	25/6 each

All the above are PM units with 2 to 3 ohms speech coils.
RTC 12in. heavy duty 20 watts model 15 ohms Speaker 17 6
Speech Coil £5 5 0 Bin. Mains Energised Speaker £1 1 0



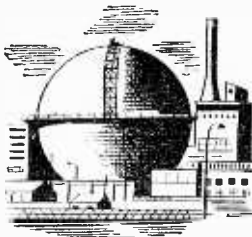
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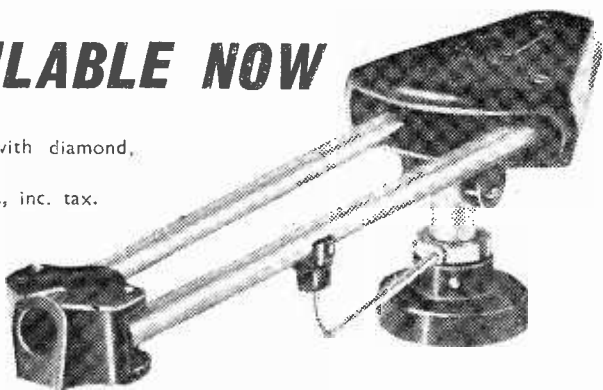
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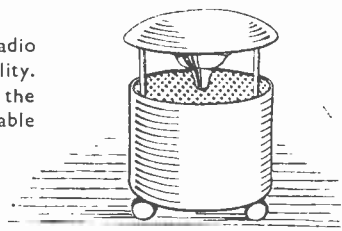
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M.M.2)

PRACTICAL WIRELESS

EVERY MONTH
VOL. XXXIV, No. 620, AUGUST 1958
COMMENTS OF THE MONTH

EDITOR : F. J. CAMM

26th YEAR
OF ISSUE
BY THE EDITOR

THE PRINTED CIRCUIT

THERE has not been a large response from readers in reply to our request for their opinions as to whether they would be interested in a P.W. printed circuit receiver. Those who have written are in favour but the number is insufficient to warrant, at present, the publication of the design which we have in hand. There is still time, however, for you to let us know your views before the autumn. Some readers point out that using a printed circuit there is no room for experiment.

THE TRANSISTORISED MIDGET

THERE can now be no doubt that readers in larger numbers are interested in really midget receivers of the transistorised type. We have already published designs and others are in hand. The demand for components for such receivers has been considerable. Readers, in fact, are becoming transistor-conscious judging from the substantial post we receive on the subject from readers asking for special designs. These have all been passed to our development department for consideration. The constructor public, too, is taking a much greater interest in high fidelity, V.H.F., and stereophonic reproduction, and we propose, in succeeding issues, to devote space to them.

EX-GOVERNMENT EQUIPMENT

WILL readers please note (and we have stressed this on previous occasions) that we cannot undertake to supply circuits or operating instructions for ex-Government equipment, nor can we undertake to modify such equipment to suit individual requirements. Before purchasing such apparatus, readers should ensure from the suppliers that technical details can be supplied. All stocks of service sheets have been distributed years ago, and are no longer available.

THE RADIO SHOW

WE shall be exhibiting our range of technical books and periodicals on our stand, Number 108, and we extend our usual cordial welcome to all readers to call at that location to discuss their problems. The Radio Show takes place at Earls Court, London, on Wednesday, August 27th to Saturday, September 6th.

AN OPPORTUNITY

THERE is a vacancy on the staff of this journal for an editorial assistant having knowledge of radio and electricity and we should be glad to receive applications from interested readers who should state their age and give details of their education and experience. Applicants should be between the ages of 17 to 21. A reasonable technical knowledge is, of course, a necessity and ability to read circuits an advantage. Address applications to Assistant, PRACTICAL WIRELESS, address as on this page.—F.J.C.

Our next issue, dated September will be published on August 7th.

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The Editor will be pleased to consider articles of a practical nature. Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

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Round the World of Wireless

By "QUESTOR"

Broadcast Receiving Licences

THE following statement shows the approximate number of Broadcast Receiving Licences in force at the end of April, 1958, in respect of receiving stations situated within the various Postal Regions of England, Wales, Scotland and Northern Ireland. The numbers include Licences issued to blind persons without payment.

Region	Total
London Postal	1,037,868
Home Counties	1,042,078
Midland	767,130
North Eastern	968,773
North Western	740,810
South Western	642,827
Wales and Border Counties	397,894
Total England and Wales	5,597,380
Scotland	698,022
Northern Ireland	178,540
Grand Total	6,473,942

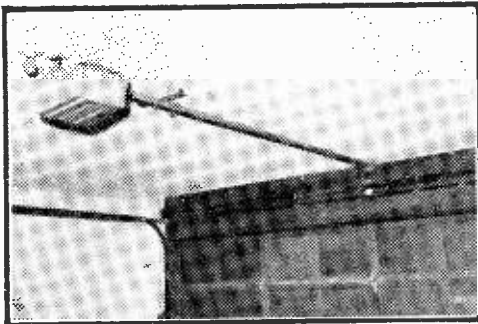
Radio and TV Maintenance Courses

THE maintenance courses on radio and television organised by the Middlesex County Council and held at the Wesley Evening Institute, London, N.W.10, are to be continued for the 1958/9 session.

The course consists of theory and practical work. The new session will commence with enrollment on Monday, September 15th, advanced enrollments may be made by post to Mr. E. N. Fennell, B.Sc., Wesley Institute, Wesley Road, Stonebridge, London, N.W.10.

Classes for Radio Amateurs

CLASSES for radio amateurs are held at the Brentford Evening Institute, Clifden Road, Brentford, under the aegis of



A radio-controlled electronic garage door opener.

the Middlesex County Council. The classes comprise instruction for obtaining the P.M.G.'s licence and servicing, including TV. The classes are held from 7 p.m. to 9 p.m., commencing September 22nd. Further particulars are available from the Education Office, Town Hall, Chiswick, London, W.4.

Earth Satellite Observations

OBSERVATIONAL work on artificial earth satellites has recently been added to the research programme of the Radio Research Station of the Department of Scientific and Industrial Research. It introduces a new technique for research on the propagation of radio waves and the study of physical conditions in the outer atmosphere.

The station will act as an international centre to collect the results of observations made by other scientists. There are vacancies for those with suitable qualifications.

Electronic Garage Door Opening

THE illustration below shows the new radio-controlled electronic garage door opener made by the Wells-Gardner Co. in America. In operation a button on the dashboard of the entering automobile is pressed to open, close and lock the garage door. At the same time, the light inside the garage goes on with the opening of the door, and goes off with the closing of the door.

Some of the important features are: permanent lubrication, control with push button or radio even while the door is in motion;

automatic stopping of the door when it comes into contact with an object; screw-drive, assuring positive action not obtainable with chains or cables; full $\frac{1}{4}$ h.p. motor with built-in overload protection and automatic reversing; power to lift any door up to 20ft. wide and 8ft. high; and convenient push buttons which can be installed in any room, so that operation can be controlled inside the home. The system operates on 110v., 60 cycle, and is powered by a $\frac{1}{4}$ h.p. motor in conjunction with a screw and nut.

Complete details and prices are available from Ad. Auriema Inc., 85, Broad Street, New York, 4, New York.

BBC Oscilloscope Order

THE BBC has placed contracts and orders valued at over £16,000 with E.M.I. Electronics Ltd., for the company's Type WM.2 TV oscilloscopes, line selectors and ancillary units.

This version of the WM.2 oscilloscope has been specially designed for monitoring television waveforms, and will be used by the BBC at transmitting stations, switching centres, studios and outside broadcast units.

Special consideration has been given in the design to ensure that the instrument meets all essential measurement requirements associated with sine squared pulse and bar testing techniques which are now being widely accepted as a standard method for rapidly checking the characteristics of video transmission lines and networks.

Stereophonic Records

PYE RECORDS are now distributing their stereophonic records — nine L.P.'s under the Pye-Nixa label and one Nixa, 45 e.p. record.

Japanese Transistor Sets

A BOARD OF TRADE notice to importers details the quotas for imports of certain

goods from Japan, for the period ending March 31st, 1959.

Transistor radios to the total value of £20,000 may be imported during the period. Full details are available from the Board of Trade, Horse Guards Avenue, London, S.W.1.

"Records"

A MONTHLY record supplement entitled "Records" is being produced regularly by Decca and it will replace all previous supplements. It is issued to dealers in lots of 1 doz. copies at 4d. a copy.

Satellite TV Stations

IT is possible that the BBC will build satellite stations to improve TV reception in areas where it is known to be bad, particularly in South Dorset. A prototype satellite station will shortly be tested.

L.P.R. Advances

DURING February and March this year, the production of 78 r.p.m. records showed a considerable decline. In March, for example, the figure was 2,481,000, for February it was 3,363,000 and for January, 5,672,000. The production of 33½ r.p.m. records increased from 1,215,000 to 1,680,000 for February.

For the first three months of this year, the total production of all types of records was 21,400,000 as compared with 22,000,000 for a similar period in 1957. This includes the 7in. 45 r.p.m. microgroove discs which themselves show a 91 per cent. increase on a year ago.

New Tape Recorder Company

A COMPANY under the name of Fi-cord Ltd., has recently been formed to manufacture in this country a new light-weight transistor portable tape recorder of Swiss design.

The "P.W." and "P.T." Radio Show Stand

OUR stand number at the forthcoming Radio Show at Earls Court is 108. The show commences on Wednesday, August 27th, and finishes on Saturday, September 6th. A cordial welcome is extended to all readers.

"Major Racket"?

MR. HAROLD WILSON, in the House of Commons, alleged that there was a "major racket" in television servicing. The R.T.R.A. has asked for further details for investigation. Mr. Wilson was speaking in the committee stage of the discussion on the Finance Bill when the question of purchase tax on television tubes arose. The Solicitor General said there were sound reasons for taxing cathode ray tubes at the same rate as the set into which they are fitted.

Mr. Wilson interjected: "We all know what happened. Unless one is an expert on television matters, and anything goes wrong with the set, one sends for someone to look at it, and one is invariably told that one needs a new tube. Who knows differently? As often as not, if they put in a new tube, it is not a new tube at all, but a reconditioned one, and heaven knows what happens to the tube taken from the set. There is a major racket going on and on the racket the Treasury exacts this high rate of purchase tax."

TV Relay for Bath

THE Bath Surveying Committee have recommended the City Council to authorise a TV relay system in which BBC and ITV signals are fed.

In view of the fact that Bath is a difficult reception area, due to its geographical area, Bath residents will welcome the recommendation. No company has yet been appointed to operate in the city area.

ITV for Northern Ireland

THE Postmaster General stated in the House of Commons that he hopes the link to enable Independent Television to be extended to Northern Ireland will be ready about the end of 1959, which is the target date for the Belfast Station on Black Mountain. The P.O., however, states that they cannot provide the necessary link from the mainland earlier than November. ITA estimate that there are 800,000 potential viewers in Belfast area. The ITA hope to have a transmitter in operation in Londonderry some time before 1964.

House Magazine Awards

THE House Magazine *Tone* issued by the Automatic Telephone and Electric Company Ltd., was considered the best house journal of the year in the results of the National House Journal Competition for 1958. Its editor received the Industrial Editors Trophy. The magazine also won an award for being the best journal in its class.

Aerial Talk Postponed

THE lecture on Antiference Band 3 acrials planned for June in the Tyne-Tees area was postponed and will now take place in September, after the Radio Show.

Coming Event

THE A.S.C.E. Film Premiere will take place at the Mayfair Hotel on October 7th.

Tees-side Amateur Radio Club

AT the Annual General Meeting of the above club held recently the following were elected officers:

Chairman, J. B. Harding. G3JYH; Treasurer, A. E. Moon. G3KBM; Hon. Sec., A. L. Taylor. G3JMO.

The club meets on alternate Fridays throughout the year at Settlement House, Newport Road, Middlesbrough.

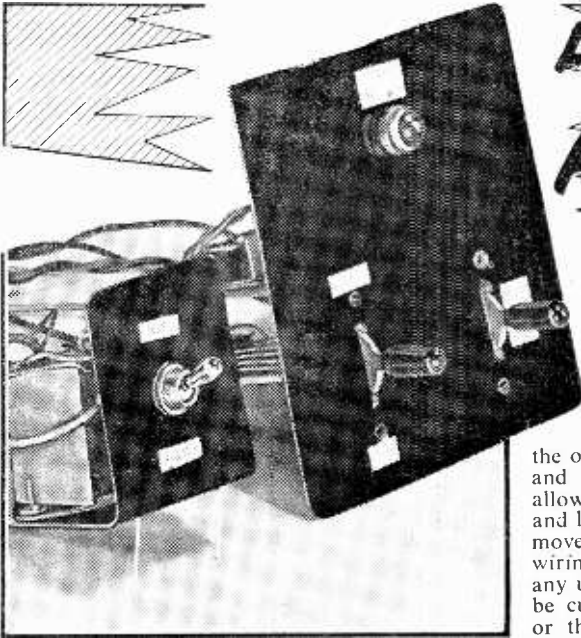
Enquiries and interested persons may contact the Hon. Sec. at 2, Endsleigh Drive. Tel. 86933.

The primary interest of the club is for the transmitting amateur; a high proportion of the membership is licensed. Would-be hams are particularly welcome.

More Radio Courses

TWO courses will be held next session, one assuming no knowledge of radio and covering the whole Radio Amateurs' Examination syllabus, and the other a more advanced course including practical work, for students with knowledge of basic theory. Enrolments will take place between 6 and 8 p.m. on September 15th, 16th and 17th, and classes will commence on September 23rd. The instructor will be G. P. Anderson, A.M.I.E.E. (G2QY).

Address: Northwood Evening Institute, Potter Street, Northwood Hills.



AN ADDACOMM UNIT

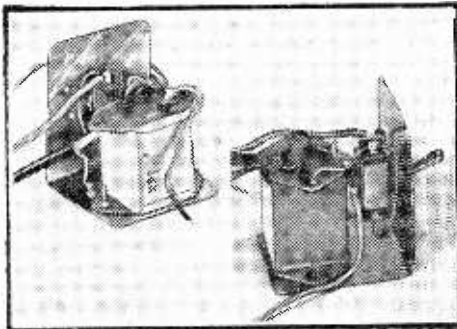
DESIGNED PRIMARILY FOR USE WITH
A RADIO RECEIVER OR LOW-POWER
AMPLIFIER

By J. Brown

THIS unit gives contact between any two or more points. One circuit gives talk/listen communication, the other with little modifications will give talk/listen plus the advantage of calling. The unit is simple and is designed primarily for use with a radio set or low power amplifier. Many of the PRACTICAL WIRELESS designs will suit. The wiring, seemingly complicated at first, becomes simple as the job progresses. We will show the master unit and slaves, also the modifications required which can be added at a later date. Fig. 1 shows the first circuit. T1 is a 100:1 ratio mike transformer, preferably screened, the secondary or high resistance side is permanently connected to the pick-up of gram sockets, the secondary to S1, as is the speaker transformer and the set's internal speaker. Firstly, we may have to modify the original set internal speaker connections; in Fig. 1 we see that one side of both speaker and speech coil and the output transformer must be connected to chassis.

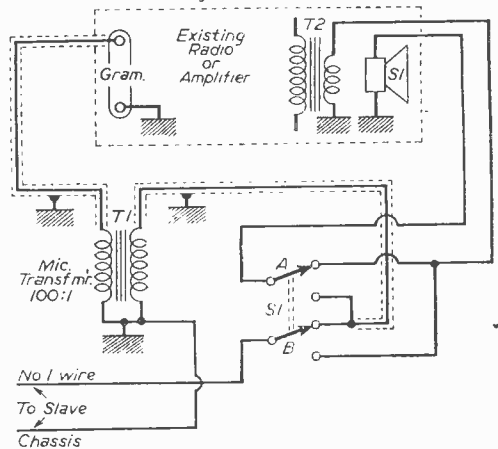
the other connections to S1, as is the slave speaker and the microphone transformer. Operating S1 allows both slave and master to be able to talk and listen to each other, by a simple up and down movement of the switch. Fig. 2 shows the slave wiring. On wiring and testing should there be any undue amount of hum, this can in most cases be cured by reversing either or both slave leads or the leads from the mike transformer to the pick-up sockets. This unit must never be used on sets or amplifiers with live chassis.

The unit has successfully been used with both A.C. and battery sets. Fig. 4 is the adapted circuit with facilities for call/talk/listen, similar to Fig. 1, which includes a push and a buzzer to each slave unit, plus a push and a buzzer at the master unit. The power is drawn from a bell transformer, or a winding on the mains transformer of the set or amplifier may be used. This winding must have one side earthed. A heater winding usually has one side earthed.



Showing the talk/listen unit.

Where T2 is the original output transformer and S1 is the original loudspeaker



S1 shown in Up position Slave talks, Master listens
When in Down position Slave listens, Master talks

Fig. 1.—Circuit of master unit.

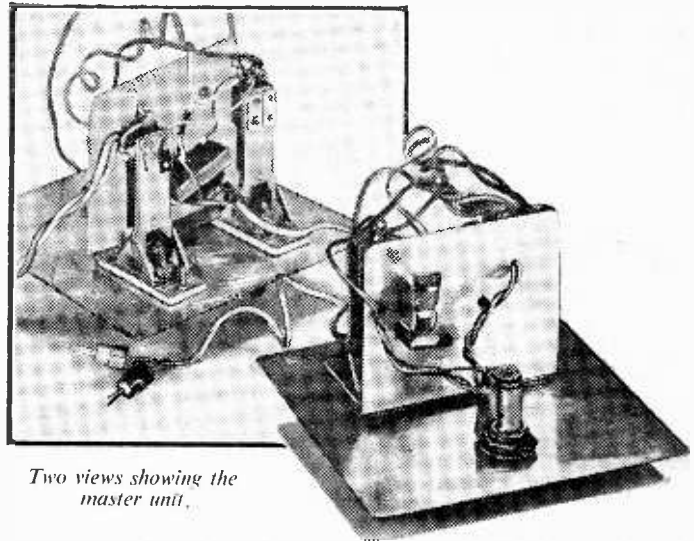
The Slave Unit

The slave unit for use with this circuit is given in Fig. 3. The slave is also modified, the added components being a switch, S2, to select either speaker or buzzer, plus a push for slave to call the master. The master calls slave by operating S3.

The master is able at all times to be in touch with the slave, one disadvantage being, the master can listen to conversation at the slave end at all times, which is essential in the case of the unit being used as a baby alarm. The master can operate S1 and talk or listen to the slave by operating S1 to the talk or listen position.

Talk/Listen/Call Circuit

Slave calls master by pressing the call button, master hears the buzzer in master unit, operates S1 so that he can talk to and answer the slave. On the finish of contact master returns S1 to normal position, slave returns S2 to buzz or



Two views showing the master unit.

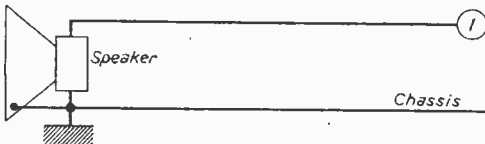
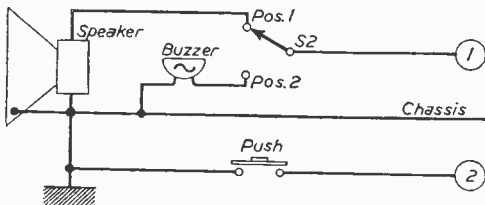


Fig. 2.—The slave wiring for circuit shown in Fig. 1.

call position and the unit is ready for use again. It should be pointed out that should the slave switch S2 be left in the speak position, the master can still call the slave as the A.C. will cause a hum in the speaker, which will let the slave know the master is calling.

Multi Slave

It will be appreciated that where more than one slave station is required other problems have to be faced. In Figs. 5 and 6 the modifications needed are given for more than one slave. The switch, S4, is the selection or secrecy switch, also each line from the slave No. 2 line is fed to the

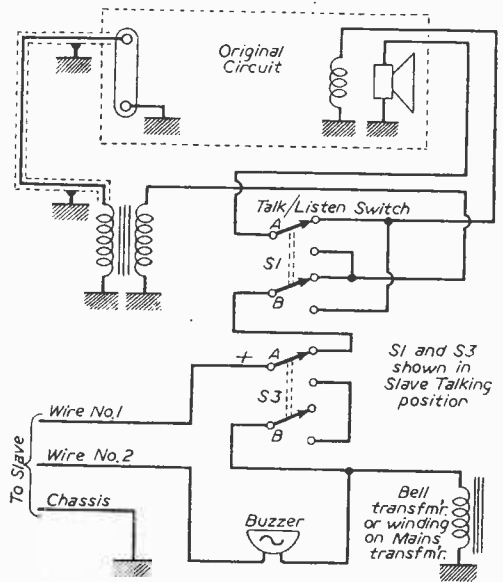


S2 Normal position is in the Buzz Call position. As explained in text this is immaterial, as Speaker or Buzzer will give audible warning.

Fig. 3.—Slave wiring for circuit shown in Fig. 4.

A.C. winding via a lamp and a buzzer in parallel with each other. When the slave presses the call button the lamp and buzzer associated with the calling circuit operate. The master then switches S4 to the required position and contact is made.

In Fig. 1 all the starred connections are to earth or chassis. The mike transformer secondary is connected to the socket marked pick-up, gram or input, via a screened lead. The internal volume



S3...Call/Operate Switch... Press Down, A.C. from winding feeds to Slave via S3 and calls Slave. In Up position removes A.C. and brings S1 into action.

Fig. 4.—A modified version of Fig. 1.

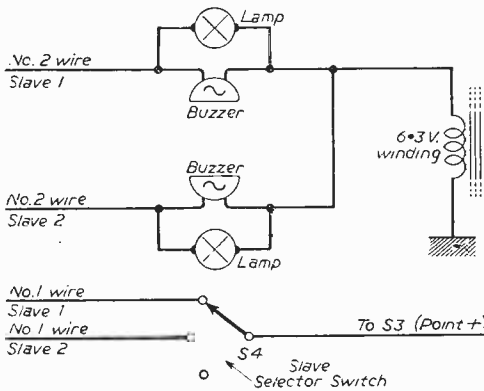


Fig. 5.—Modification to circuit shown in Fig. 4.

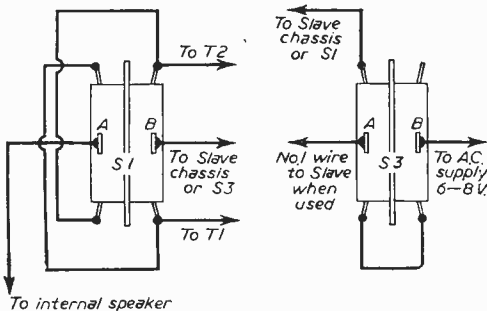


Fig. 5A.—Showing the connections for S1 and S3 when using double-pole toggle switches. On the right we see the connections for S3, the calling switch; on the left we see the connections for S1, the talk/listen switch. These are given to show the connections more clearly and to save the reader having to work out the connections.

control is still in operation and must be turned to a convenient position. If the set is controlled, the wavechange switch must be set at gram. Keep the mike transformer away from the mains transformer as hum may be introduced. S1 may be mounted in any convenient position on the cabinet. The switches used may be either double pole/double-throw type or Post Office key type switches. The connections from the slave to master in the case of circuit 1 can be ordinary twisted flex; for circuit 2 two separately screened cables are required. Co-axial cable will give good results. Fig. 3 shows the slave unit for the circuit in Fig. 4; S2 selects the speaker or buzzer, the push button for calling is on its own line. In the up position the switch makes the speaker connection. If needs be a lamp may be wired parallel with the buzzer to obtain audible and visual indication of the call.

Circuits

Fig. 4 being the modified version of Fig. 1 needs explanation. There are three lines: to the slave No. 1, to switch No. 2, which selects either speaker or buzzer, line 2 which is the calling line

carrying the A.C. from the master to the slave. When S3 is pressed the A.C. travels from the winding to the slave via contacts on S3 through line 1 to the slave. the other connection being the line starred, which is the common earthed connection. This voltage is approximately 6-8 volts. Master calls slave by pressing S3. On the release of S3, the contacts on the top side A of switch brings the talk-listen circuit into action, and the slave operates S2 to answer the master. When finished the slave returns S2 to the buzz position, master returns S2 to normal position.

Fig. 5 shows the modifications needed to circuit 4 when more than one slave is required. Each No. 2 line from the slave has a panel mounting lamp and a buzzer to indicate to the master which slave is calling. If slave 1 calls, the buzzer is operated and the associated light for No. 1 slave lights up. The master can then by selecting No. 1 slave (by using the second modification the addition of S4), select the station. The requirements for each slave are one lamp and one buzzer. The line No. 1 from each slave is broken at point + and S4 wired in. Each No. 1 wire from slave will then go through S4 and each No. 2 wire from slaves goes to the lamp/buzzer. In this case when the master requires a certain slave, he will have to make switch S4 to the correct position. This gives absolute secrecy to each slave, both on the talk/listen positions, so one slave never hears the conversation carried on with another.

Fig. 6 shows an alternative modification in which one buzzer can be used in the master unit for all slaves. It should be emphasised that in Fig. 6 the components should be as follows: The lamps should be 6-8 volts 300 m.a., and the buzzer a Minibuzzer (made by V. & E. Freidland), as these in series with the supply must have the same current consumption and the Minibuzzer has a consumption of approximately 300 m.a. If we do not follow this either the buzzer works and the lights do not light or vice versa. The line (from slaves) No. 2 is fed via a lamp in series with the buzzer and the A.C. winding.

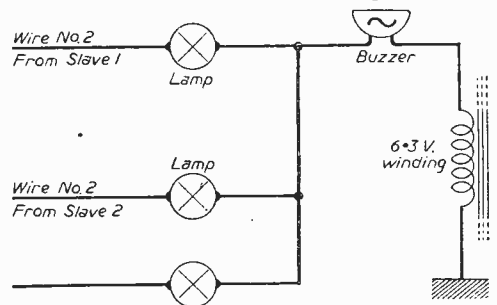


Fig. 6.—An alternative modification in which one buzzer can be used in the master unit for all slaves.

PRACTICAL WIRELESS CIRCUITS

16th Edition

By F. J. CANN

10/6, by post 10/11

From

GEORGE NEWNES, LTD.,

Tower House, Southampton Street, Strand, W.C.2.

STEREOPHONIC SOUND

USING AN ADDITIONAL CHANNEL IMPROVES FIDELITY

By J. Gordon

ALTHOUGH remarkably good sound reproduction is possible by way of a single-channel, the use of an additional channel results in an improvement in fidelity which has to be heard to be appreciated. Single-channel sound systems are now available to the music-lover and enthusiast which have a frequency response which is essentially flat from 50 c/s to 30 kc/s, which are capable of pushing out some 30-50 watts of audio with a total harmonic distortion as low as 0.1 per cent, and which respond with ease throughout the fantastically large dynamic range demanded of certain orchestral works. Nevertheless, there is definitely something lacking.

Single-channel System

The single-channel sound system is limited by the fact that there exists but one circuit between the microphone at the studio and the loudspeaker at the listening room. It matters not whether the circuit is completed by way of wires, a radio link or a recording medium. The single-channel system is illustrated in Fig. 1 (a).

The effect is precisely the same if two or more microphones are used at the studio and two or more loudspeakers are used at the listening room provided one circuit is used between the microphones and loudspeakers. This arrangement is shown in Fig. 1 (b).

The Stereophonic Effect

A listener actually in attendance at a concert, for example, hears the sounds from the various instruments over a very wide front. This effect obviously cannot be secured by the use of a single

loudspeaker in the listening room. The size of the reproducing sound source can undoubtedly be enlarged by the use of two or three parallel-connected loudspeakers set out in front of the listener, but the effect is still not the same as listening to a live concert in the concert hall.

Without the use of his eyes, a listener seated in front of an orchestra can establish the position of the various instrumentalists without the least difficulty. He has the feeling of "presence" and "perspective" of the orchestra. The reason for this is that he is making use of both of his ears over the wide sound front: sounds originating at the right of the listener are first picked up by the right ear and then by the left ear, and sounds originating at the left of the listener are first picked up by the left ear and then by the right ear. Sounds thus arrive at the listener's ears from various angles, and the two ears operate in a way as to discriminate between the relative intensity and phase of the sound waves over the wide front.

A sound originating at the right of the listener, for example, will be picked up by both the right and left ears, but the right ear will respond first and at this ear the sound intensity will be greater than that at the left ear; the phase of the sound will also differ between the two ears. The results abstracted by the ears in this way are passed on to the brain, and the sense of perspective is brought into action. In the case cited, the brain will automatically compute that the sound is arriving from the right of the listener.

From this reasoning, therefore, it is fairly plain that a single-channel sound system can never provide the illusion of presence and perspective. Two loudspeakers are of no help in this connection, either, since the sound at both loudspeakers is proportionally the same as that at the position of placement of the microphone at the studio or concert hall. Neither are two microphones any good because the signals lose their separate identity over the common circuit.

The only way out of the problem is by the use of two isolated channels—a channel for each ear. A two-channel stereophonic system introduces the required three-dimensional intelligence. A two-channel set-up is illustrated in Fig. 2.

With two channels it is much the same as

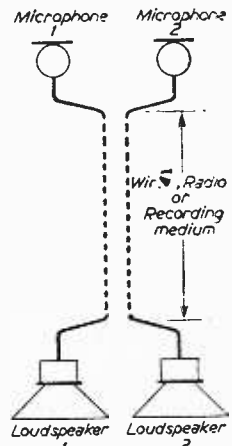


Fig. 2.—The two-channel or stereophonic sound.

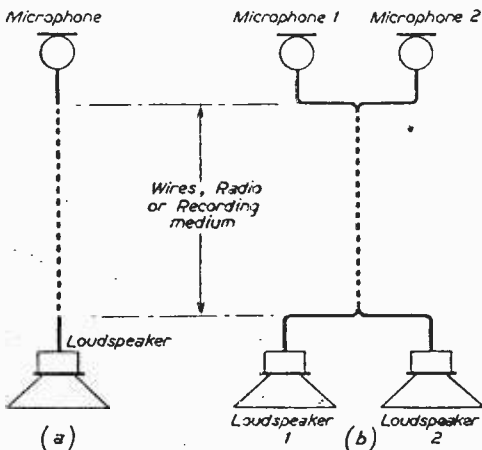


Fig. 1.—Single-channel system: (a) One microphone and one loudspeaker; (b) two microphones and two loudspeakers.

extending the two ears of the listener from the two loudspeakers in the listening room to the two microphones at the studio. The microphones discriminate between the phase and intensity of the sounds arriving at the various angles from the sound front, and the loudspeakers pass their messages on to the listener, who now gets the illusion of perspective and is able to position the

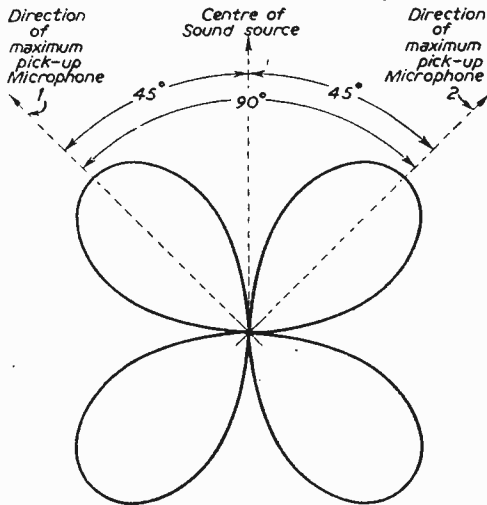


Fig. 3.—A diagram showing the arrangement of the microphone system for stereophonic sound.

various instrumentalists of an orchestra with little difficulty.

At this point it should be made clear that, although two channels admirably provide the stereo illusion and give infinitely better reproduction than that ever possible on a comparable single-channel system, for optimum results more than two channels are required. The cinema people use multi-channel stereo systems to embrace fully the wide front of the auditorium, but from the economics of the thing we shall have to be content with two channels for a long time to come.

Position of Microphones and Loudspeakers

When stereo was first experimented with the microphones were placed side-by-side with a reasonable distance between them. The idea now, however, is to use two microphones as close as possible together, mounted one above the other. Microphones with figure of eight polar responses are employed, and these are orientated for an angle of 90 deg. between their axis of maximum pick-up, and the microphone system as a whole is adjusted so that the axis of maximum pick-up of each microphone falls at an angle of 45 deg. in relation to the centre of the sound source. This is illustrated in Fig. 3.

In the listening room the two loudspeakers are separated by about 6ft. and turned at a slight angle, as shown in Fig. 4, so that the axis of the loudspeakers cross at a point in front of the zone of stereo effect. Although, as would be expected, the point of optimum stereo effect

is where the axis of the loudspeakers cross, as indicated by the X in the diagram—slight movement from this point tends to upset the balance and disturb the illusion. A much more general area of stereo is found as indicated in the shaded region of the diagram.

It has been discovered that when the same sound is radiated simultaneously from two sources, the listener senses that the sound originates essentially from the source whose sound reaches the ears first. However, it has also been discovered that if the intensity of the delayed sound is increased the effect can be neutralised and eventually reversed. Thus, a listener positioned at point A in the stereo zone (Fig. 4), will receive sound from both loudspeakers simultaneously; and if the sound levels are balanced and the sounds are in-phase, the sound will appear to be coming from a point directly between the two loudspeakers. If the listener moves to point B in the stereo zone, he will become closer to loudspeaker 1 and the sound from this source will reach his ears first, but since he is also moving into the beam of loudspeaker 2 the intensity of sound from this source will increase, and the tendency for unbalance will be neutralised. The same thing in reverse occurs if the listener moves towards point C in the stereo zone.

Maintaining correct relationship between the phases of the sounds of the two channels is important. If an announcer standing in front of the stereo microphone system at the studio causes in-phase signals in the microphone circuits,

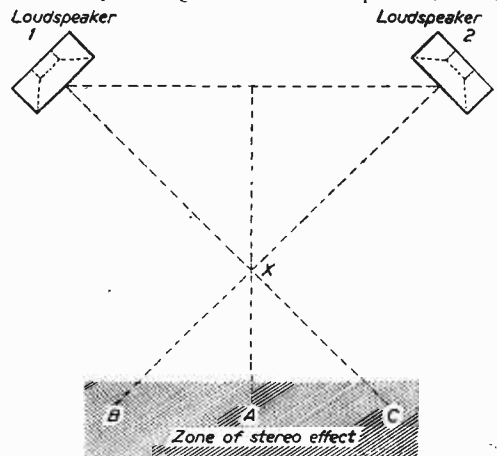


Fig. 4.—A diagram showing the best position for stereophonic loudspeakers.

then the loudspeakers will also have to be connected in-phase. When this condition exists and the sound levels from the loudspeakers are balanced, the sound will appear to be originating from a point directly between the two loudspeakers, as we have already seen. However, if the loudspeakers are out of phase, sound will be heard coming from both loudspeakers as well as from a point between them. This effect was revealed to a number of experimenters during the recent stereo tests made by the BBC.

REMOVING REACTION FROM TRF RECEIVERS

By A. Sydenham

THIS ARTICLE DEALS WITH THE THREE-VALVE ARRANGEMENT

THE TRF type of receiver continues to find favour amongst constructors partly on account of its simplicity and resultant economy of construction. Many quality enthusiasts use TRFs also, but usually with reaction omitted, and whilst sensitivity might not be as high as that offered by a superhet the fidelity of reproduction of such apparatus can approach that of F.M. equipment. And, incidentally, not all F.M. receivers are faultless!

This article, however, deals with the more modest receiver—the three-valve arrangement—in which the first valve operates as a R.F. amplifier, the second as a leaky grid detector plus audio amplifier and the third as an output stage. Sensitivity, not high under normal conditions, is usually stimulated by means of controllable reaction in the detector stage.

By and large, the use of reaction is undesirable but in simple superhets and where presetting is possible it can sometimes be used advantageously. Unfortunately, effective reaction presetting is rarely possible in a TRF circuit as the amount of feedback tends to vary with frequency and thereby necessitates a variable control. Many users, aware of the obsolescence of such a control, would doubtless like to remove it as tuning is made difficult for all but the experienced. To do so, however, is not easy due to the resultant severe drop in sensitivity and selectivity.

The lack of selectivity arises due to damping of the intervalve tuned circuit by the detector

grid, this grid performing, for demodulating purposes, the function of a diode. This grid is also part of a L.F. amplifier so that the valve is forced to play a double rôle, the result of which is that, unless C1, R1, R2 and R3 (Fig. 1) are carefully chosen, severe distortion results. In order to obtain reasonable quality R1 must be fairly low in value but, unfortunately, damping increases as the value of this resistor is lowered. If, in an attempt to improve selectivity, R1 is made high in value, the higher frequencies become severely attenuated.

It is not reasonable to expect a valve to perform two functions, satisfactorily, viz., that of detecting and also of amplifying, simultaneously and as the requirements of the former are opposite to those of the latter perfection is never achieved.

Tackling the Problem

A fairly normal leaky grid plus reaction arrangement is illustrated in Fig. 2. The reaction winding, L3, is usually tightly coupled to the grid winding and feedback is controlled by means of C5, the reaction control. Adjusting this control invariably makes necessary a further adjustment to the main tuning control. It is assumed that the receiver covers the medium and long wavebands.

Perhaps the best method of removing reaction from such a circuit, yet at the same time retaining selectivity, is to dispense with the leaky grid

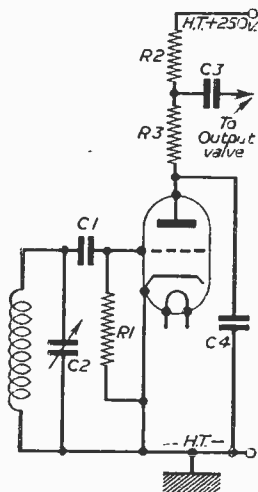


Fig. 1.—Unless C1, R1, R2, R3 are carefully chosen severe distortion results.

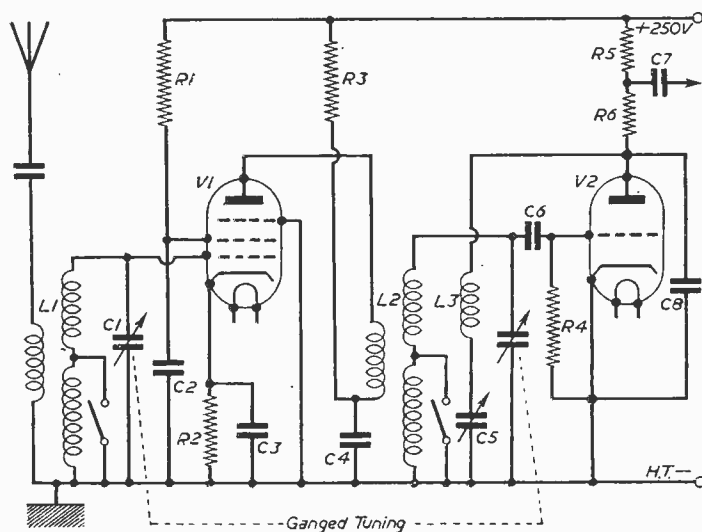


Fig. 2.—A fairly normal leaky grid plus reaction arrangement.

detector altogether, using in its place one of the "infinite impedance" type and following it with a stage of L.F. amplification. This method is generally practicable as, by using a suitable double-section valve, extensive chassis alterations are rendered unnecessary and only three valve-holders are required as before.

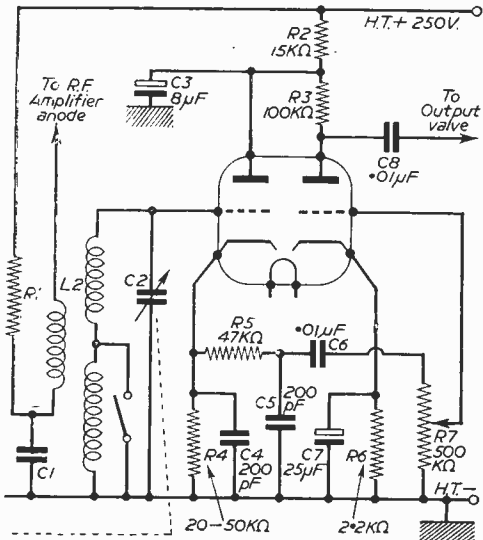


Fig. 3.—Modification of circuit shown in Fig. 2.

Is It Worth While?

Yes! Considerable improvement results from modifying the circuit of Fig. 2 to that of Fig. 3, where V2 has been replaced by a double-triode as mentioned earlier. The anode of the left-hand section is made earthy and the output, taken from its cathode, feeds into the second half of the valve via a conventional filter network. This second section acts as a normal L. F. amplifier with a volume control in its grid circuit.

The modification is generally easily made and no additional holes need to be drilled either in the chassis or in the cabinet as the volume control takes the place of the previous reaction control. Where higher gain is required a triode-pentode may be used.

The modified circuit also provides improvements both in gain and selectivity. It will be necessary to realign the receiver on completion of the modifications and it will be found that any trimmers associated with the intervalve circuit now tend to peak sharply, whereas before they tuned flatly.

Sensitivity can also be improved slightly by soldering a short length of insulated connecting wire to each section of the fixed vanes of the twin-gang tuning capacitor.

These wires, not bared, are then twisted together and the receiver tuned to the high frequency end of the tuning scale, when oscillation will occur. The wires are then slowly untwisted and shortened as required until oscillation just ceases.

Another Version

The output of the infinite impedance detector is positive. If a negative output is desired for A.V.C. purposes, or to operate a "magic eye" tuning indicator, the arrangement shown in Fig. 4 will be found suitable. A germanium crystal diode now performs the demodulating process but is preceded by a triode offering a high impedance input. It will be appreciated that should the triode stage be omitted the intervalve tuned circuit will be appreciably damped by the diode in similar fashion to when the detector was a leaky grid type.

The choke in the cathode circuit offers considerable impedance to R.F. but if its D.C. resistance is low the diode is not biased. The R.F. developed across the choke is demodulated by the diode, the resulting A.F. being passed in the usual way to the audio amplifier.

Conclusion

As TRF receivers are so many and so varied, readers will appreciate that it is not possible to quote component values which will give optimum results in all cases; however, those specified will ensure reasonable efficiency—the rest depends upon experiment.

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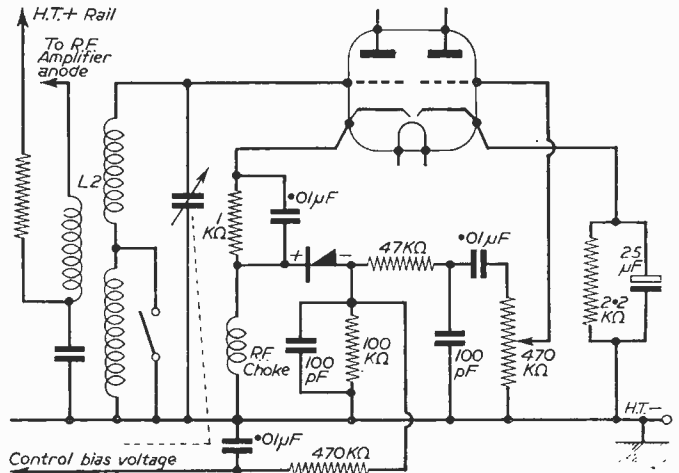


Fig. 4.—Arrangement for obtaining a negative output.

Servicing Radio Receivers



KOLSTER-BRANDES MODEL NG20

By Gordon J. King, A.M.I.P.R.E.

THIS is a contemporary-style radio-gram built into a small cabinet of pleasing design with short, slightly displaced legs and a "let-down" front which exposes the radio controls and gram unit. The radio controls are "Tuning," "Wavechange," "Volume" and combined "Tone on/off." Waveranges covered are the normal L.W. and M.W. (2100 to 1030 metres and 570 to 187 metres respectively), plus the V.H.F.-F.M. waveband over 3.5 to 3.0 metres (87.5 to 100 Mc/s). In common with the general trend, the S.W. band is dropped in favour of V.H.F.

Incorporated within the cabinet are a self-contained ferrite aerial for L.W. and M.W. and a horizontal dipole aerial for V.H.F. These aeri- als are essentially for use in areas of reasonably high signal strength, and it is as well to remember that they are considerably directional, particularly the ferrite aerial which has a sharp minimum and broad maximum pick-up, which may influence the positioning of the receiver. The internal dipole is terminated by wander plugs, which should be connected to the sockets A1 and E on the aerial panel—it sometimes pays to reverse the plugs to secure the best results.

The socket A2 is for the connection of an external aerial for L.W. and M.W., which may be

necessary in poor reception areas and where screening prevents the use of the ferrite aerial. If reception on V.H.F. using the internal dipole is poor, an external dipole should be used. This may range from a simple indoor installation to a three-element array mounted high on the chimney stack, depending on the prevailing signal conditions. It must be stressed that the full advantages of the F.M. system of broadcasting can be obtained only by supplying the receiver with a strong interference-free signal, and in fringe areas due attention to the aerial installation is well warranted.

A simple aerial can be made for indoor use from a length of twin-conductor p.v.c. covered wire, connected across the aerial terminals (A1 and E), run to the picture rail and then split horizontally so that each section extends about 30in. along the rail in either direction.

Where an external V.H.F. aerial is used, it can also serve to pick-up the ordinary A.M. signals by connecting the feeder to sockets A1 and A2, instead of A1 and E. For the elaborate F.M. aerial, coaxial feeder of 75 ohms impedance is recommended.

The receiver can be used only on 50 c/s A.C. mains—200 to 250 volts, since a fully isolated,

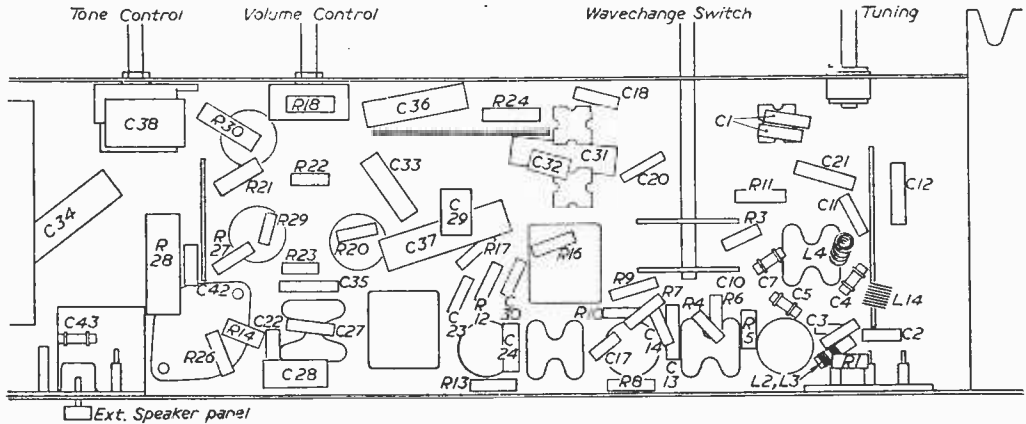


Fig. 1.—Underview of chassis showing layout of components.

mains transformer is used in the power section. The gram section features a Type UO-8 BSR autochanger unit and crystal pick-up.

The Circuit

The circuit is fully detailed in Fig. 2. A total of six valves, including the rectifier, is used. On F.M. the six are in use as follows: V1 R.F. amplifier and frequency changer; V2 I.F. amplifier; V3 I.F. amplifier; V4 detector/limiter and A.F.; V5 output; V6 rectifier. On A.M. V1 is switched out of circuit, V2 becomes the frequency changer, V3 remains as an I.F. amplifier, the F.M. detector of V4 is switched out and a simple diode A.M. detector is switched in, while the triode section remains as an A.F. amplifier. The first F.M. stage uses one of the triodes in

V1 as an earthed grid R.F. amplifier; the signal in the aerial coil L2 being induced in L3, which is flatly tuned by reason of the low shunt impedance, and applied to the cathode circuit. The stage is biased by the volts drop across R2. Coil L2 acts as a load to the medium frequency aerial signals.

The other triode section operates as a self-oscillating frequency changer, and the amplified R.F. signals across L4 are applied to the point of minimum oscillator signal, being the junction of C8, C9. From previous articles, it will be remembered that the oscillator is arranged in the form of a bridge circuit so that the R.F. coupling can be made at a null point to avoid the oscillator signal being fed back to the aerial.

The F.M. tuning capacitors are in gang with (Continued on page 441)

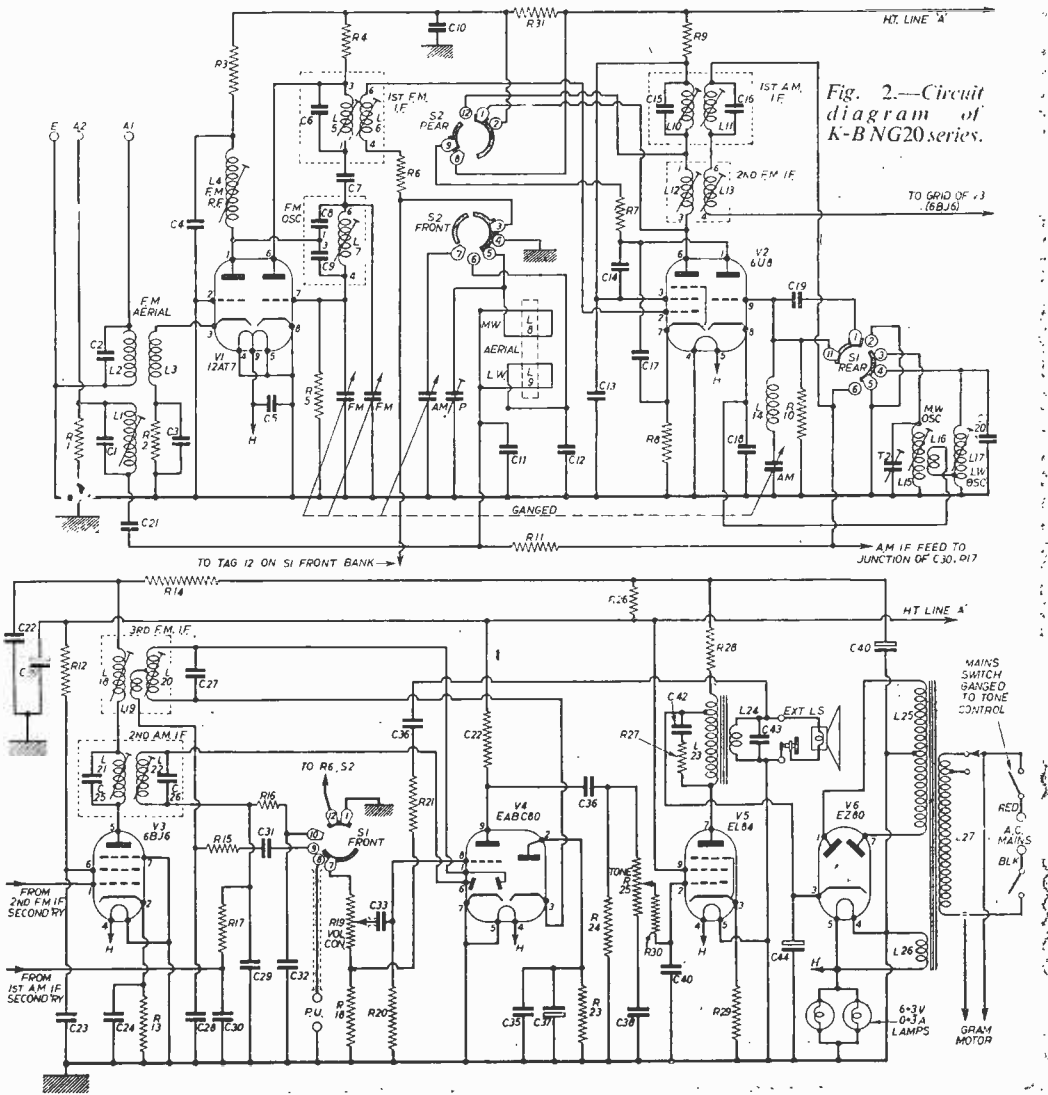


Fig. 2.—Circuit diagram of K-BNG20 series.

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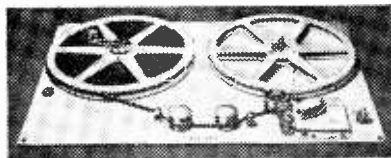
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C5—1,000 pF.	C30—.04 μF 150 v.	R11—220K Ω.
C6—20 pF.	C31—.02 μF.	R12—33 K Ω ± 10%.
C7—1,000 pF.	C32—100 pF.	R13—68 Ω.
C8—30 pF.	C33—.05 μF ± 25%.	R14—2,200 Ω 10%.
C9—30 pF.	C34—.25 μF.	R15—47 K Ω.
C10—.01 μF ± 25%.	C35—1,000 pF.	R16—47 K Ω.
C11—.003 μF ± 10%.	C36—.02 μF.	R17—22 M Ω.
C12—50 μF ± 5%.	C37—2 μF 150 v.	R18—220 Ω.
C13—1,000 pF ± 10%.	C38—.003 μF.	R19—.5 M Ω.
C14—.01 μF.	C39—10 μF.	R20—10 M Ω.
C15—70 pF ± 5%.	C40—20 μF.	R21—2.2 K Ω.
C16—80 pF ± 5%.	C41—25 pF.	R22—470 K Ω.
C17—.01 μF ± 25%.	C42—.01 μF ± 25%.	R23—39 K Ω ± 10%.
C18—10 pF.	C43—1,000 pF.	R24—680 K Ω.
C19—410 pF ± 1%.	C44—30 pF.	R25—.25 M Ω.
C20—300 pF ± 2%.	R1—330 Ω.	R26—1,000 Ω ± 10%.
C21—.01 μF.	R2—150 Ω.	R27—4.7 K Ω.
C22—.01 μF ± 25%.	R3—220 Ω.	R28—20 Ω ± 10% 2 w.
C23—.003 μF ± 10%.	R4—10 K Ω.	R29—100 Ω ± 10%.
C24—3,000 pF.	R5—22 K Ω.	R30—100 K Ω.
C25—8 pF ± 2%.	R6—150 Ω 10%.	R31—220 K Ω.

C31 to the volume control R19. The section which follows is common to both services: the signal at the volume control being applied to the grid of the triode of V4. In amplified form, the signal is redeveloped across R22 (anode load), from whence it is taken to the control grid of the output valve V5, by way of the tone control R25.

The output transformer has a tapped primary winding, the upper section of which passes the H.T. current not only for the output valve, but also for the whole of the set. Such an arrangement eliminates the need for a smoothing choke, since it is capable of neutralising hum. A conventional full-wave

rectifier circuit is adopted. On A.M. a high resistance (R31) is introduced in series with the H.T. feed to the F.M. tuner section by switch S2 rear. This not only mutes the tuner but also keeps a very small potential on the anodes of V1 so as to avoid cathode poisoning. The same switch section also shorts the primary of the second F.M. I.F. transformer, while S2 front introduces the appropriate aerial winding and S1 front switches out the ratio detector and switches in the diode A.M. detector.

rectifier circuit is adopted.

The triode section of V2 is also energised, and serves as the A.M. oscillator, the required band being selected by S1 rear. Both the ferrite aerial windings and the oscillator coils are tuned by the composite gang, in the usual manner. The resulting A.M. I.F. signals (422 kc/s) are amplified by V3 and end up at the A.M. diode of V4 where they are demodulated. The audio signal appears across the volume control and is conveyed through the remainder of the receiver.

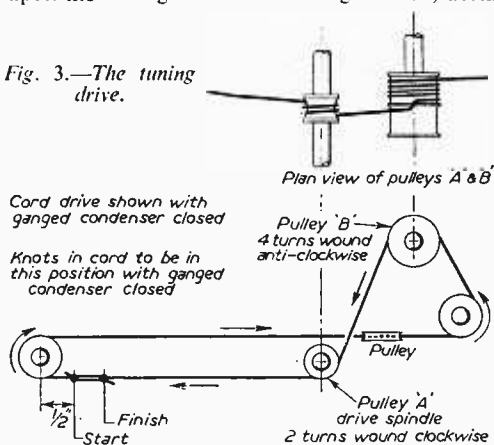
The D.C. content of the I.F. signal, present at the junction of R17 C30, is used as an A.G.C. bias and is fed back to the controlled valves V2, V3.

Whilst most combined receivers employ a completely separate V.H.F. tuner unit, the F.M. front-end of the NG20 series is built along with the rest of the receiver on a common chassis. Extreme care is necessary, therefore, during a servicing operation to avoid undue disturbance to the wiring and components associated with the V.H.F. circuits. Possibly, the most critical components are C8 and C9 in the oscillator coil can. These have a negative temperature co-efficient value to secure thermal stability of the V.H.F. oscillator; replacement components must be of identical type.

It is not desirable to alter the tuning of the I.F. transformers—to peak them for greater sensitivity.

Servicing of this series is a relatively straightforward matter; the chassis is easily removed from the cabinet, if necessary, and the components are highly accessible. The tuning drive may cause a little confusion, as shown in Fig. 3.

Fig. 3.—The tuning drive.



appear in series. The low impedance of L6 at the medium frequencies, however, has little influence on the normal medium-frequency performance.

Series-connected A.M. and F.M. I.F. transformers load both V2 and V3, as is usual practice, and the selected signal appears either across L20 (F.M.) or L22 (A.M.) in the anode of V3. On F.M. two diodes in V4 serve as a ratio detector, and the demodulated A.F. signal is developed across C28, and fed by way of S1 front, R15 and



On Your Wavelength

BY THERMION

Improving it Worse!

IN the June issue I commented on the modern tendency of musicians to "arrange" other people's work, a form of plagiarism which many, including myself, do not like. Musicians should compose their own music and leave existing compositions to be played as the composer intended. Arranging is a form of musical conceit, intended to give the impression that the arranger is a sort of superior mentor, making good the defects of his masters. Several readers agree with me, and up to the present there have been no dissentients. The Reverend J. Rodger, of Grange-mouth, writes thus: "I think you are being very kind when you call travesties of compositions 'arrangements.' In fact, over the years, one has time to note the number of original compositions re-crocheted, re-quavered, welded, riveted and hammered up in a new suit of composition armour; one discovers that there seems to be no limit to a series of 're-dis-arrangement.' One is forced to the conclusion that the original composition was mighty poor stuff, but now that it has been allowed out of the re-dis-arranger's psychiatric ward it will be more reconciled to the world, the flesh, and the devil. Most of the old tunes are satisfying in their established originality, but let an expert re-dis-arranger meditate on it, and diagnose its diseases, and it won't be long before it is discharged at the public as a blast of cacophonous concatenation or an opiate of saccharine mellifluity." I can, of course, excuse some arrangements such as, for example, Clut-sam's arrangement of Schubert's music in the musical play, "Lilac Time." I regret that Borodin's music should have been borrowed for the revival of "Kismet," which was a straight play and never intended to be put to music. Grieg's music, adapted for the "Song of Norway," also seemed appropriate. My criticisms apply to just plain arrangements. Liszt was one of the offenders in this respect.

Gospel Broadcasts

MR. DAVID BUSHELL, of Leeds, states that the gospel broadcasts take place on six nights a week, not five, and that there are only two quarter-hour programmes. They all do not emanate from America, however, about a third of them are entirely British. Some of them, no doubt, are excellent and sincere, but readers will know the programmes to which I was referring.

Stereophonic Sound

COSMOCORD, makers of the well-known Acostereo Cartridges which were among the first in the world to be completed, are early off the market in the new stereophonic age. They tell me that they have installed a sound-testing set-up to study the acoustical and electronic

problems involved in the development of stereophonic equipment. They have increased their staff, and the first stereophonic Acostereo Cartridge is in production.

Safety of Portable Electric Tools

MOST amateur handymen and that, of course, includes wireless constructors, possess an electric tool. Official statistics show that the annual number of accidents caused by portable electric tools is high, about 50 people being killed annually by ineffective earthing systems on these tools. Many more have sustained injuries. Gresham Transformers Ltd., have recently been conducting field tests with prototypes of the Gresham Earth Lead Tester. It is designed for 240v., 50 cycles, single-phase supply, and it is being produced in collaboration with Her Majesty's Inspectors of Factories, and has been subjected to official test. The instrument makes its rapid test by ascertaining the continuity and adequacy of the earth lead of tool or appliance. The heavy current of 100 amps. is passed through the lead for 2 seconds, and the resistance of the lead is measured and compared with the resistance before the main test. If the lead is defective to the extent of requiring examination the resistance after the heavy current has been passed through will be higher than initially. If there is an open circuit the resistance will be infinite, whereas if the resistances before and after are identical the resistance is satisfactory.

Sponsored Radio

THE vast number of viewers who now watch the sponsored TV programmes (and their numbers increase) raises the question once again of whether the BBC would do better in view of the competition of television to re-open the question of sponsored sound broadcasts, and to examine whether the opposition originally raised to it is still in line with present public opinion. Has the public become inured to the injection of the advertising into the programmes?

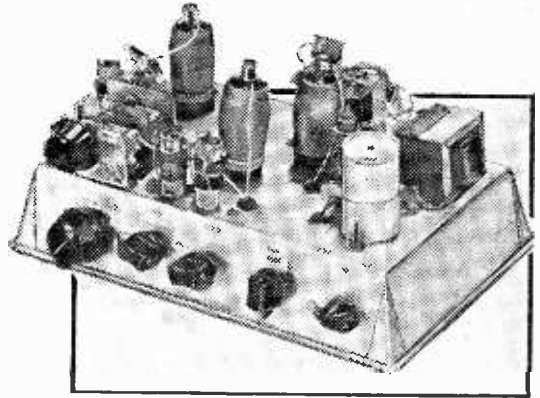
It would seem so if television experience is any sort of a yardstick. When sponsored programmes were tried in this country, in the '20s, they were not successful, but it may be that they were then ahead of their time. My readers might like to consider this and let me have their views.

Sound or Vision?

MANY of my correspondents state that whilst they have installed TV "for the benefit of the family, and the sake of peace," they still prefer sound radio and do not enjoy watching TV. There is not so much room for experiment with a TV set as there is with radio, and some of the women who have written to me are devoutly grateful that their menfolk do not play about with the TV.

A Beginner's CONSTRUCTIONAL COURSE - III

A NEW SERIES WRITTEN ESPECIALLY FOR
THE AMATEUR By E. V. King
5.—FITTING A SEPARATE L.F.
VOLUME CONTROL



TEST the completed receiver. Stations which interfered with one another will not now do so. There will be less hum, but you may have to retrim the condensers C5 and C6. The procedure remains the same as given last month. If you are keen to get every ounce of volume from the receiver you may adjust R3 or use a twisted wire capacitor between C5 and C6 to get the utmost feedback at full volume setting as explained last month. This latter is not necessary and would not probably be carried out on most small commercial receivers of this type. The values given are good ones and will suit the beginner well.

or it would be distorted (keeping V2 as a detector).

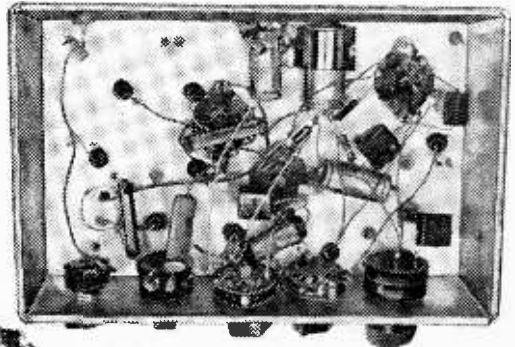
The author has, however, after many experiments and calculation, arrived at some values for the resistors associated with V2 which are suitable for amplifier and detector with only a different anode load being switched in. Details are shown in Figs. 23, 25, 28, 31 and 32.

Fix a suitable plug at the back of the radio, a post office jack or co-axial connector would be quite suitable. Usually one side is earthed when it is bolted on, if not then connect one side to earth.

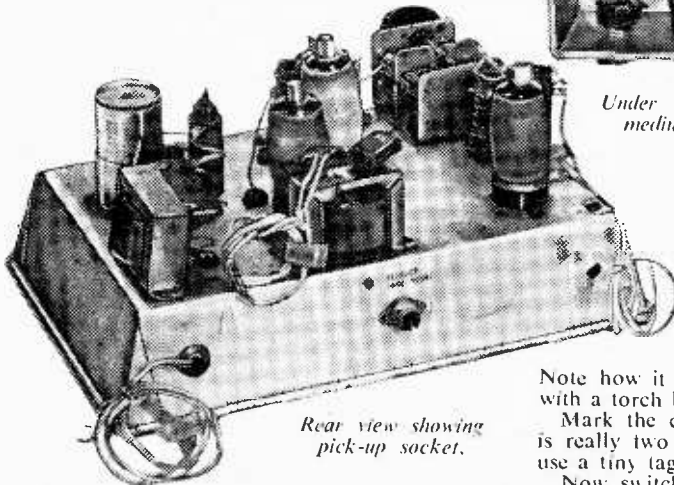
A rotary switch (S2 and S3), which will connect one lead two ways and another lead two ways, is

Wiring-in a Pick-up Plug

Provided you are not a really Hi-Fi fiend you can operate a pick-up or microphone quite satisfactorily on this receiver. By rights one ought to feed the pick-up signal between chassis and the top cap of V2, switch in another value for R12 and another for R8. Remember that most sets fitted with a pick-up plug have an L.F. stage before the output stage. This one has not and we have to alter the working conditions of our detector valve to those for an L.F. amplifier or we would not get enough volume (using V3 only)



Under view of receiver modified for long medium waves, tone control and pick-up.



Rear view showing pick-up socket.

required. This can usually be bought with both "poles" and contacts on one wafer, but a two wafer switch may be used. Fig. 31 shows a typical plan of a one-wafer switch of this type (2-pole two-way).

If you are a beginner it will be well to spare a little time in examination of this switch.

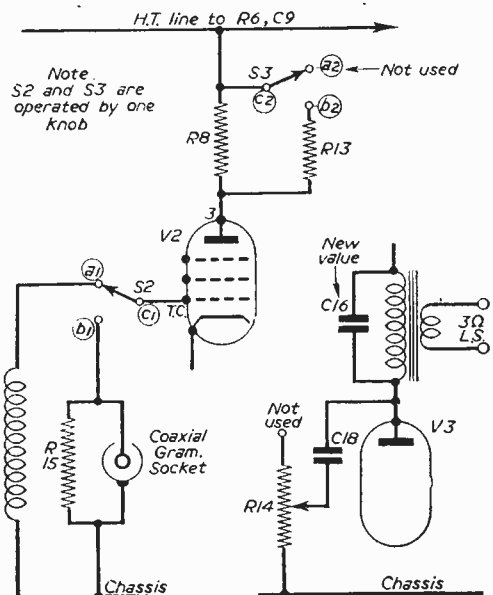
Note how it works. Test any doubts you have with a torch battery and flash-lamp bulb.

Mark the centre pole of each "switch" (this is really two switches in one) with the letter c, use a tiny tag of paper for this purpose.

Now switch over one way and mark the two

new contacts then made with the letter "b."
 Switch over the other way and mark the new contacts then made with the letter "a."
 Now when the switch is in one position the contacts made are c to a (S2) and c to a (S3). In the other position c to b (S2) and c to b (S3).

Switch on the radio, switch over S2 and try out the receiver using pick-up or earpiece as a microphone. It should work after a fashion, but will, at this stage, be distorted. If it does not work at all you have wired up the last part of S2 wrongly and you must put it right before going on to wire in S3 to cure the distorted amplification.



Figs. 25 and 27. (Left) Switching for gram/radio. (Right) Wiring of tone control.

Do not proceed with alterations to the wiring until you have done this and are sure you have done it correctly.

Connections to S2 (one part of this switch)

Disconnect the lead from the top cap of V2 to the red tag of the PHF2 coil. Connect this top cap by as short a wire as possible with tag "c" on S2. All leads in this section must be short even if the result is untidy or you will have feedback troubles later. Now wire the tag "a" of this same switch to the red tag of the PHF2 noting that you have not disturbed the lead already going to C6.

Put switch in such a position that "c" is joined to "a." The receiver is now virtually as it was before. Verify that it is still working. If it does not then you have wired the switch incorrectly.

Still working on the same switch connect the tag "b" to the centre pin of the plug you have fitted on the back. Take a grid leak R15 from this pin to earth.

Now connect an earpiece (headphone), pick-up or crystal microphone to the socket.

Connections to S3 (other part of this switch)

The distorted amplification of the valve as tried out above may be corrected by arranging to switch in R13 in parallel with the anode load R8. To do this join tag "c" of this switch to junction of C9 and R6, i.e., take it to H.T.

Join the "b" tag to one end of a 22 k resistor (R13) and the other end to pin 3 valve 2.

Leave tag "a" open circuit without any connection.

Now test again as before. Conditions on "radio" should be just as they were, but on "gram" the distortion should have disappeared. To all but the most musically educated people the reproduction will be satisfactory, the tone control to be fitted later will operate and reduce needle "hiss," etc., but there is no volume control at this stage in building. One can be fitted on the pick-up turntable.

Fitting a Volume Control

The wiring for a volume control as fitted to the pick-up panel is shown in Fig. 29. A good all-round value for the control would be 1 megohm for crystal pick-ups unless the maker states otherwise. The higher this value is made the more likely is the possibility of hum being introduced into the circuit. With ordinary cheap magnetic type pick-ups obtainable for about 25s. use a low value of control, between 100 and 250 k would be suitable. With all crystal pick-ups or microphones a screened lead is essential, the outer one going to the chassis. On this type of receiver the cable should have an outer insulated covering as well. A moving-coil or carbon-type microphone may be used, but they will require a special matching transformer. Always make sure the set is plugged in correctly to the mains or, there is a possibility of the pick-up or microphone becoming live. - This

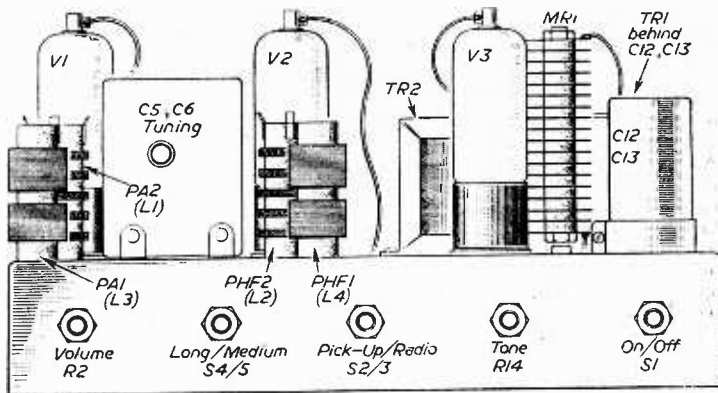


Fig. 26.—Front view of receiver.

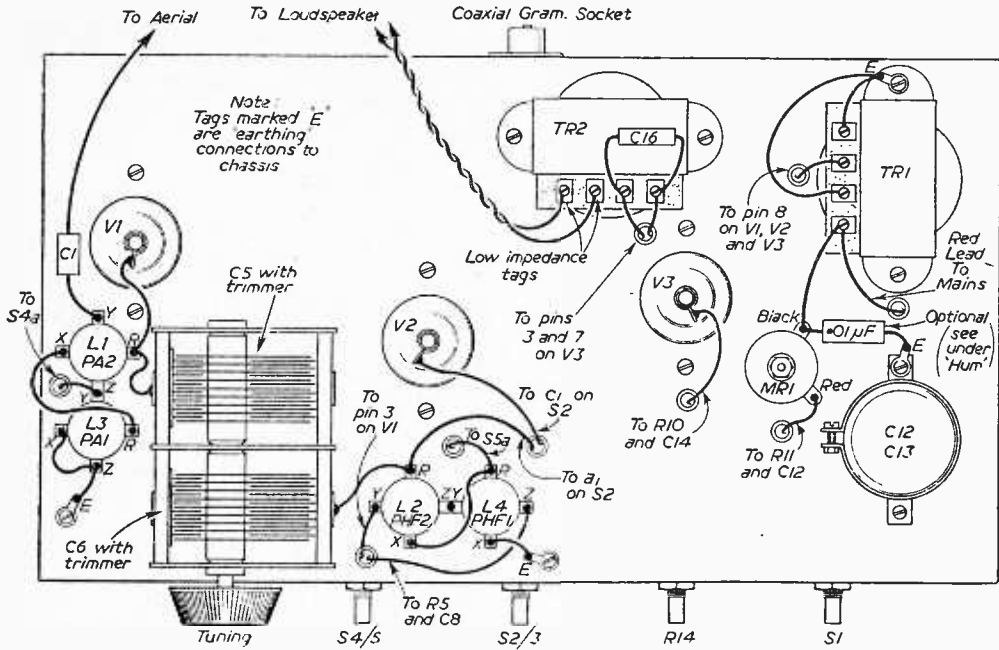


Fig. 28.—Top view of receiver.

receiver makes a very handy baby alarm and a suggested system is now given.

A Baby Alarm System

Fit an 8in. permanent-magnet moving-coil speaker in the baby's bedroom as near as possible to the cot (hanging overhead out of reach of the child). No cabinet is necessary. Take the leads out of the room to an ordinary speaker transformer fitted just behind the radio (about 6in. to 1ft. away from the speaker transformer of the receiver itself, or feedback troubles will develop). The speaker leads go to the low-impedance (thick enamel) windings of the transformer. The high-impedance side goes to the pick-up plug. It may help to cut down hum if the metal casing of the transformer is earthed to chassis. Do not earth the speaker side of the windings; the speaker is thus isolated from mains. For added safety you could earth it separately to a water pipe. This is not at all necessary, however.

The set is switched to P.U. operation and any noises from the child will come out at really loud volume from the speaker attached to the radio. A speaker used in this way as a microphone is very sensitive indeed, ordinary speech being picked up and "broadcast" at good volume from a distance of 9ft. at least. Do not try to fix this up as a "lash up" in one room. So sensitive is the arrangement that "speaker" will feed back to speaker generating vibrations which could easily damage a small one. Always have the "microphone" speaker in another room.

Fitting a Tone Control

There are many ways and places in which a

tone control may be fitted. It is proposed to fit a simple top cut control which is especially useful with pentodes as they tend to accentuate the higher notes of the musical register. The control will allow you to "suit your ear" by cutting some of the top notes as required. This is also useful for heterodyne whistles so annoying in the evening on the medium waveband and for needle scratch on old gramophone recordings.

The position of the tone control, R14, is shown in Fig. 26. The wiring is very simple and is shown in Figs. 27 and 32.

Here is a suggested plan to follow. Verify that

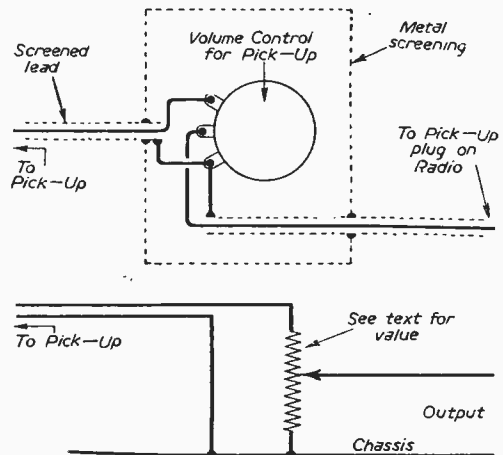


Fig. 29.—Separate "pick-up" volume control.

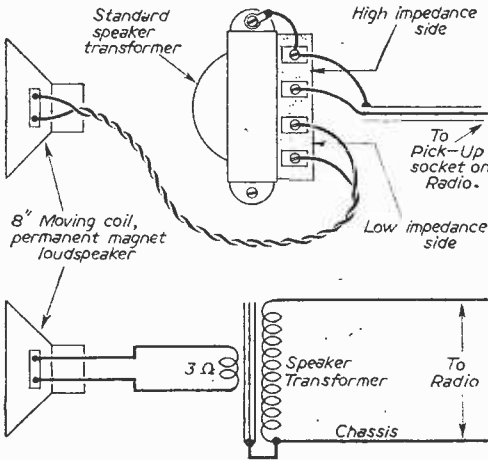


Fig. 30.—“Baby alarm” connections.

the receiver is now working. Disconnect from mains. Attach R14 firmly to the control panel. Remove C16 from the speaker transformer and replace it with a value of .005 Mfd., taking care to leave the other connections to the transformer as they were before.

Take the centre tag of the tone control potentiometer via C18 (.1 Mfd. or any other value - you may experiment safely here) to pin 3, valve 3. Leave other connections as they were before.

Take one tag of the control to any earth tag.

Leave the other tag open circuit.

Now test the receiver: you will note that when C18 is made more earthy the high notes are by-passed through it to earth, leaving a predominance of lower notes. The control range is thus, even with so simple a circuit, quite comprehensive.

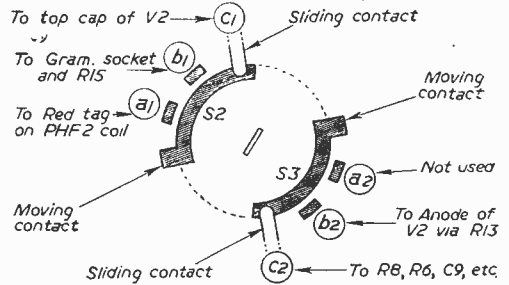


Fig. 31.—Typical switch for gram/radio.

Fitting Long-wave Coils and Wave-change Switch

A set of this type is best fitted with coils for long-wave reception as the medium-wave reception of the BBC Light Programme is very difficult in many parts of the country due to interaction after dark of the many other stations near by on the frequency spectrum. The real answer, of course, is to use (as the author does in his living-room) V.H.F., F.M. This is quite beyond the scope of the beginner.

(To be continued)

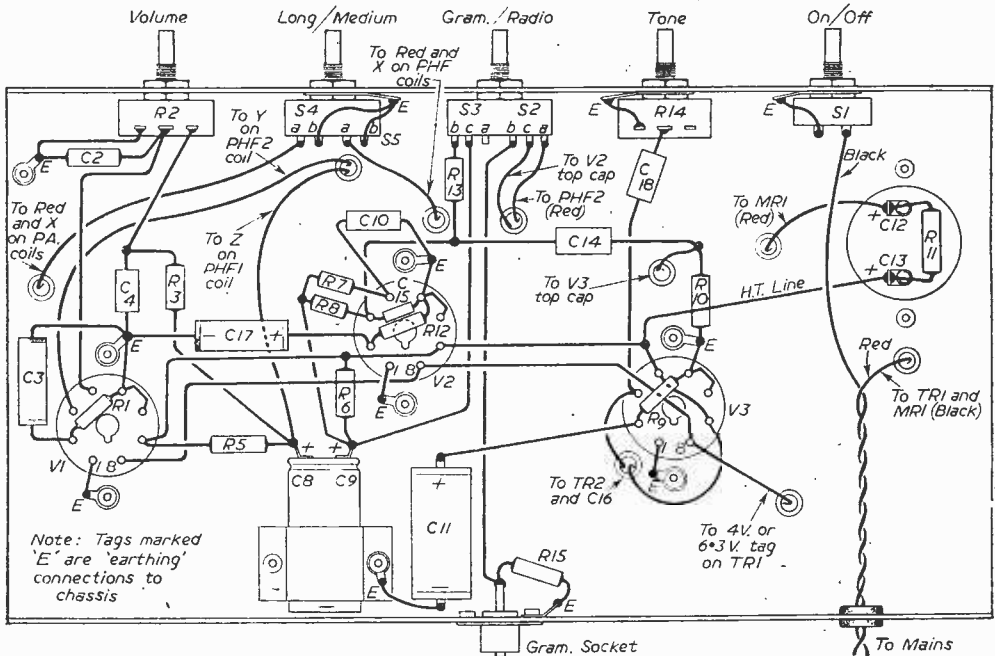


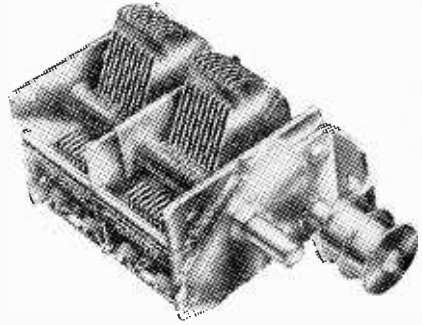
Fig. 32.—Under view of receiver.

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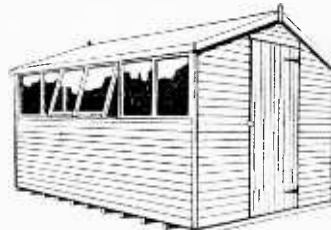
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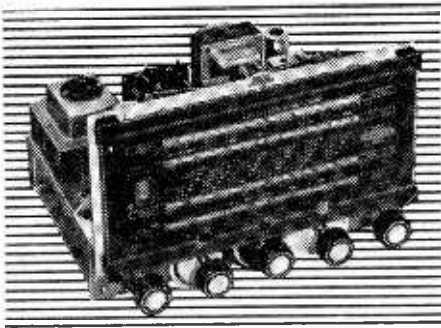
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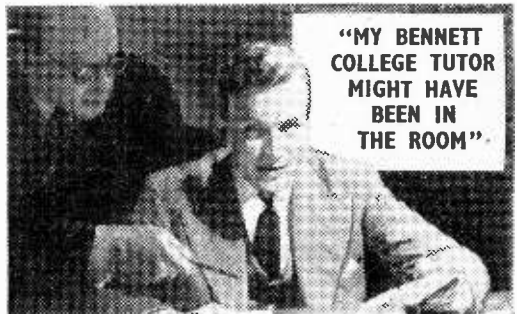
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TRANSISTORS

in Practice

9.—AUDIO AMPLIFIERS

By R. Hindle

(Concluded from page 391, July issue)

CLASS B is, therefore, the most attractive way of using transistors at the output stage.

The attraction of Class B is further enhanced by the fact that the power drawn varies with the size of signal handled, the lowest instead of the highest dissipation taking place when the amplifier is quiescent. Also, because maximum dissipation is no longer limited by the quiescent condition the Class B stage can handle an audio output up to five times the maximum dissipation of the transistors used. Clearly this means that when handling peak passages the transistor will run into a momentary dissipation higher than its rating, and if a graphical representation of the conditions, using a load line on the collector curves, such as makers provide is examined it will be seen that the load line does in fact cut across the maximum dissipation curve. This is in order because, assuming audio frequency working (this may not apply in pulse or D.C. techniques which are not the direct interest of constructors who read this journal). The heating time constant of the junction prevents it from following the dissipation fluctuations with the waveform of the sound and instead it follows the average of these fluctuations over a number of cycles.

As with earlier stages in the audio chain, three possible ways of connection are available. Common base connection is not very attractive, however, because power gain is dependent on a high load resistance whereas power output requires low loads and obviously the two requirements are incompatible. Common collector working is best from the distortion point of view due to the inherent feedback; this is an interesting circuit configuration that is better in practice than a first glance would indicate. Common emitter working is generally preferred because it requires less drive from the preceding stage for a given power output, and this configuration is used for the present design. Theoretical optimum conditions cannot be applied, however, because for reasonable distortion levels the stage must be driven from a comparatively high impedance source which prohibits optimum power coupling. This is due to the variation of input resistance of the transistor as the output stage swings towards the zero base current end of its characteristic. The resistance of the signal source (that is the supply from the driver stage) must be high by comparison in order to swamp this variation and ensure current drive conditions which have already been explained as a characteristic of transistors. The distortion of the stage due to this variation of input resistance can be

reduced by biasing the Class B stage so that at its quiescent condition (during the half-cycle being handled by the other transistor of the pair) some current is in fact drawn.

The Circuit

Fig. 49 gives the basic push-pull circuit from which it will be seen that the method of stabilisation is the same as for the earlier audio stages. A potentiometer feeds the base and a resistor is included in the common emitter circuit. Sometimes separate resistors are used in each emitter lead. The method of approach in design is much the same as that already described, taking each transistor separately and calculating the load that it needs for the output power to be given, keeping within the optimum dissipation determined by the manufacturers but not limiting the optimum power output to the dissipation because, as mentioned above, this is not where the greatest effective transistor dissipation takes place. The single transistor can be considered under Class B because the other transistor of the pair is quiescent whilst the one under consideration is operative and therefore it does not affect the situation.

The transformer ratio is also calculated for one transistor coupled to the speaker impedance to be used and this ratio gives that between one half of the transformer primary and secondary, being doubled up at the other side of the primary centre-tap. Note that it is the ratio that is doubled for the two transistors and not the load. The load figure as calculated has to be multiplied by 2², i.e. 4, to give the collector to collector load. This follows, of course, from the fact that the resistance at the secondary is multiplied by the square of the transformer ratio at the primary.

The actual design has to allow for variations in ambient temperature, component tolerances and transistor manufacturing spreads, but fortunately the makers have done the work for us. Actually a pair of Mullard OC72 transistors are used, as mentioned in the previous part, one

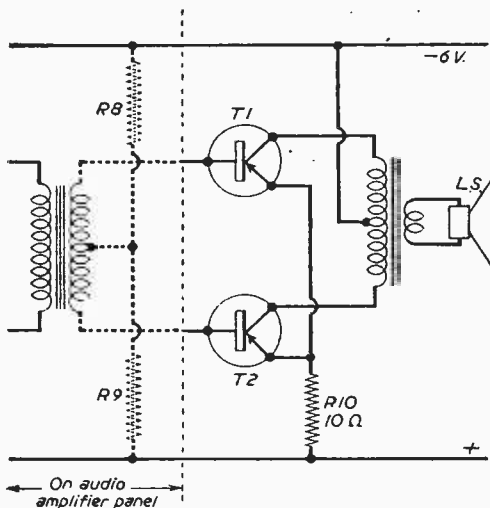


Fig. 49.—Push-pull Class B output stage.

of these having been used for the single-ended output stage. The component values recommended for 6 volt working, which is the value of the battery used for the designs in this series, are 3.3K. ohms for the upper arm of the potentiometer, 100 ohms for the lower arm and 10 ohms for the common emitter resistor. Under these conditions a quiescent current of 3 mA for the pair of transistor flows and 275 mW is delivered to a collector to collector load of 140 ohms. The load for each transistor is therefore a quarter of 140 plus the emitter

during the course of this series is used the two resistors forming the potentiometer must be mounted on that chassis. Very few components are left to be mounted and these go on the same type of tagboard as used for the audio stages as shown in Fig. 50. The same process is followed as before, leaving the transistors to be wired in last.

The tagboard Class B stage can be tested independent of the audio amplifier if required by temporarily connecting the two inputs together and wiring on between earth and the 6 volt battery tag the potentiometer values given in the circuit diagram. The current with speaker connected and 6 volts applied should be about 3 mA and a click in the speaker should indicate that all is well when the battery is connected. The potentiometer resistors are then removed, as is the temporary link between the outputs. The two outputs then go to the outside secondary connections of the interstage transformer by connections between the appropriate tags if the tagboard version of the audio stages is used, or in the case of the receiver these two leads from

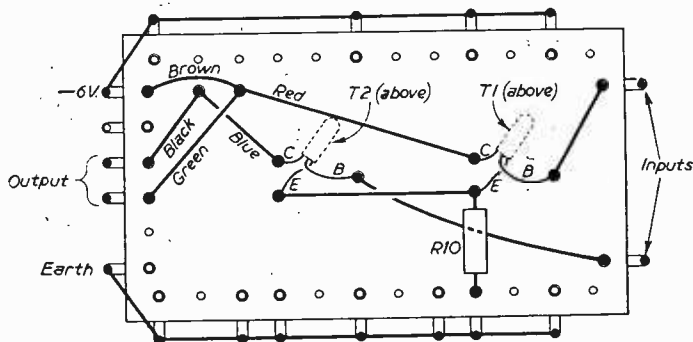


Fig. 50.—Tagboard wiring of the output stage.

resistor which is not by-passed (and therefore a small part of the output appears across it) i.e., 45 ohms per transistor.

Construction

For the sake of convenience, to avoid the need for three input leads, the base potentiometer is mounted in the audio amplifier where the interstage transistor is fixed. This is seen in Fig. 47 for the tagboard version; if the receiver developed

the transformer are connected to the two socket output strip and connections from the output chassis input tags are terminated in plugs to fit the strip. The tags for earth and battery negative on the two chassis are interconnected and leads taken to the battery, or in the case of the receiver, connections are taken from the output stage tagboard (which can be mounted at the back of the main chassis) to the tagstrip inside the receiver at which the leads from the battery terminate.

Britain's First Radiophonic Workshop

THE BBC has set up a Radiophonic workshop at Maida Vale in London, the first installation of its kind in this country to deal exclusively with the production of radiophonic effects. Thus the BBC is now equipped to provide an aid to productions which neither music nor conventional sound effects can give.

What is radiophonic sound? It is new sound—suggestive of emotion, sensation, mood, rather than the literal moaning of a wind or the opening of a door. Created by technical means from basic sounds which may vary from the rustle of paper to a note from an electronic oscillator, radiophonic sound provides the writer and producer with an entirely new field in which to convey his intentions with the utmost subtlety of expression.

Its functions are quite different from those of what is usually termed *musique concrete*, and although some of the techniques are similar radiophonic sound is not an art in itself—it is used to provide an additional "dimension" for radio and television productions.

In the short time this technique of creating sounds has been available to the BBC, several

notable productions have resulted. They include two works by James Hanley—"A Winter Journey" and "The Ocean" (to be repeated in July and August respectively). The former was produced by John Gibson and the latter by Donald McWhinnie, who also produced Giles Cooper's "The Disagreeable Oyster" and the first work written especially for the medium, Frederick Bradnum's "Private Dreams and Public Nightmares."

In setting up the workshop, to provide a permanent centre for work of this kind, the choice of technical equipment has been determined by the two categories into which radiophonic sounds mainly fall:

(1) Those which can be built up from basic material of natural sounds—e.g., voices, bells, musical instruments, etc.

(2) Those derived from wave-forms generated by electronic circuits—e.g., oscillator, white noise generators, etc.

Recordings of these sounds are put on magnetic tape and montages are built up by editing, re-recording, mixing, filtering and changing speed.

A Six Transistor 2-Wave Pocket Superhet

SUITABLE FOR RECEPTION ON BOTH
WAVEBANDS IN ANY LOCATION

By A. J. Lewis

WHEN properly adjusted this is a stable, sensitive receiver capable of distant reception on both wavebands in any location. An earphone jack is provided for personal listening which cuts out the loudspeaker when in operation. The somewhat high cost of building is offset by the satisfaction of owning one of the smallest two-waveband sets anywhere.

As the speaker used is only 1½ in. diameter, room-filling output and quality cannot be expected but for personal use the output is quite adequate and in quiet surroundings there is comfortable volume. Battery life is about 200 hours.

Circuit Details

AE1 and AE2 are the aerial windings which feed into TR1 the frequency changer. L1, L2,

L3 provide oscillation which when mixed with the signal frequency produce an i.f. of 480 kc/s. Due to the limited space the aerial trimmers C2 and C3 and the oscillator trimmers C6 and C8 are fixed instead of adjustable and their values may have to be slightly altered when the set is finally adjusted. It will be noted that when the medium wave is in circuit AE1 is short

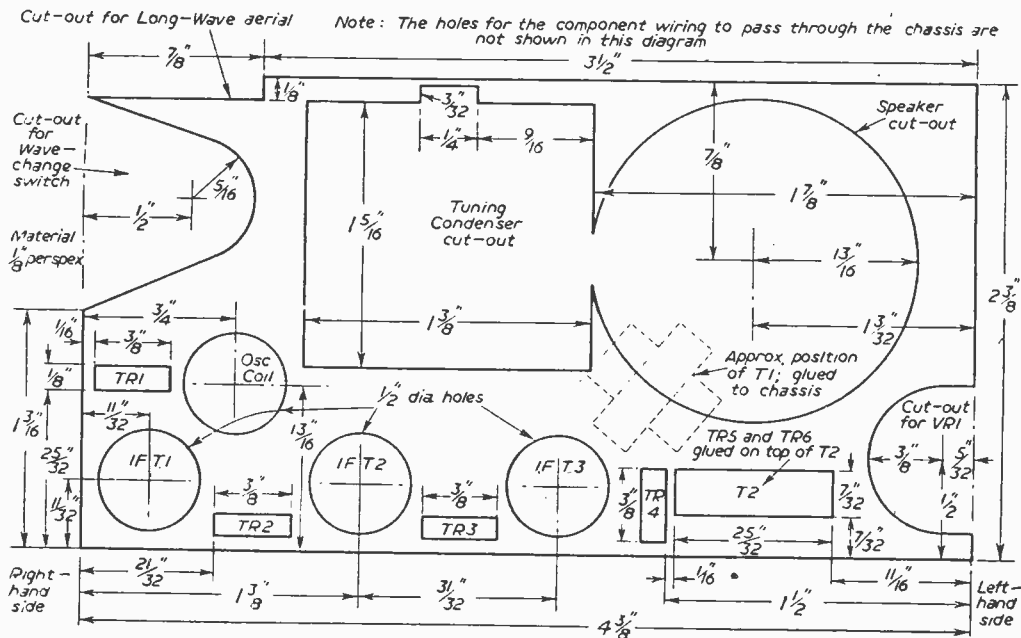
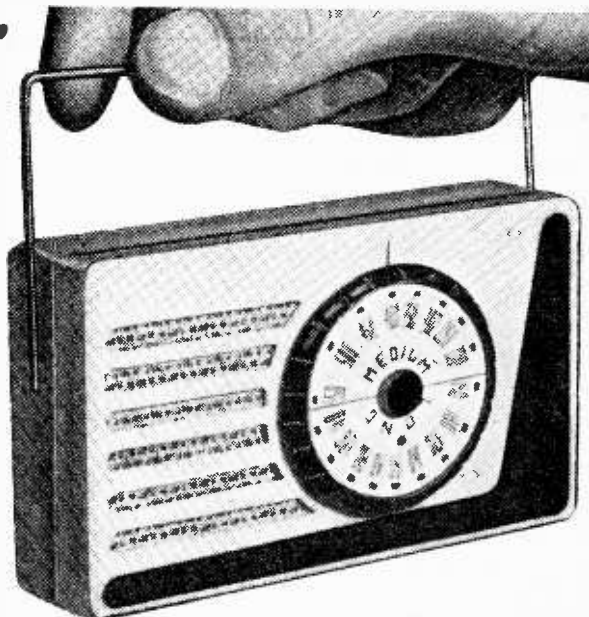
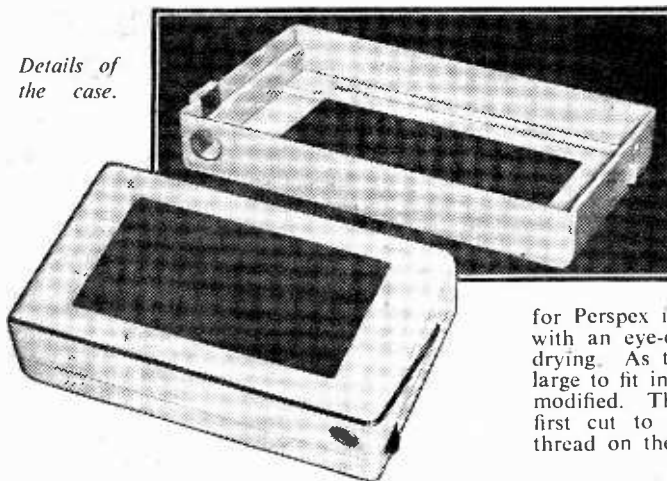


Fig. 2.—Chassis cut-out viewed from underneath.

Details of the case.



The final depth of the case will be determined by how flat this bolt can be filed. To fit the tuning condenser a piece of clear 1/16in. Perspex is cut out as in Fig. 3 with the countersunk holes drilled in the position shown. These should correspond with the holes on top of the tuning condenser. The tuning condenser is then fitted carefully into place and the piece of Perspex screwed on top. This whole assembly is then cemented into place. The correct adhesive for Perspex is chloroform, and it is best applied with an eye-dropper. Chloroform is very quick drying. As the standard type wavechange is too large to fit in the chassis, it must be considerably modified. The actual contacts on the wafer are first cut to about 1/16in. high. The securing thread on the switch should be exactly 1/4in. long

circuited to earth. TR2 and TR3 both serve as I.F. amplifiers. D1 rectifies the resulting I.F. signal and also provides an A.V.C. voltage which is applied to TR2.

Several OC44 and OC45 transistors were tried but in no case was it found necessary to neutralise the I.F. amplifier but in the unlikely event of instability the components RN1, CN1, RN2, CN2, shown dotted in the circuit diagram (Fig. 1), may be added later.

TR4 is an A.F. amplifier and TR5 and TR6 are arranged to give Class B push/pull output. As difficulty was found in obtaining a 5 ohm resistor R15 and R16 were arranged in parallel to give this value.

The small bias current necessary for TR5 and TR6 is derived from the voltage drop across R14; this being more economical of current than the more usual potential divider. The value of R14 may have to be altered slightly when the set is completed and the procedure for doing this will be described later in the article.

Decoupling in the negative power supply is by means of R17, C16, and R7, C10. When the earpiece is in circuit, the power supply to TR5 and TR6 is cut off, thereby conserving battery current.

The Chassis

The first step is to cut out the chassis from 1/4in. Perspex as in Fig. 2. The parts to be cut out should be marked with a pair of dividers. The slots for the transistors should be left till last as they can then be cut exactly between the I.F. transformers. The loudspeaker is mounted first with a good plastic-to-metal glue. The speaker flange should fit flush against the chassis. The tuning condenser is fitted next but some slight modifications to the body of the condenser must be done first. The shaft should be cut to exactly 1/4in. long, the retaining bolt in the underneath must be filed to approximately 1/32in. high. Great care should be taken not to disturb the setting of the vanes while this is being done.

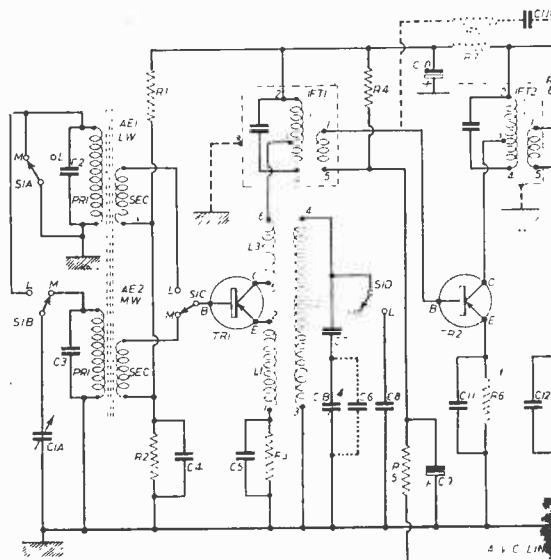


Fig. 1.—The

and as most switches available have longer threads than this it must be cut down to the correct length. This is done as follows. First the split ring is removed from the shaft and then the four clamps holding the wafer in place are gently bent outwards and the wafer removed. The shaft is then pulled out so that the thread is free to be cut to the correct length. The shaft is then put back in place and the wafer replaced.

The clamps can be bent back in a vice. Next the shaft of the switch is cut to exactly 1/4in. long and half the shaft is cut away as in Fig. 3. Finally the whole switch is filed into a square not more than 1 1/4in. from side to side. To mount the switch, a piece of 1/4in. Perspex 1in. square is cut and a 1/4in. hole to take the switch is drilled

dead centre. This piece is slipped over the switch shaft and secured with the bolt which must be filed to not more than 1/16in. high. Next a piece of 1/16in. Perspex lin. square is cut and a hole large enough to fit round the bolt on the switch is cut out of the middle of it. This last piece is cemented with chloroform on top of the aforementioned piece of 1/4in. Perspex and the whole switch assembly is securely cemented with chloroform to the underside of the chassis.

If these modifications have been correctly carried out the shaft of the switch should protrude exactly 1/16in. over the chassis.

The Oscillator Coil and Transformers

Next the oscillator coil is glued into position, followed by the three I.F. transformers, which are also glued to the chassis. The earthing strips on the transformers are pushed through the chassis and joined together as shown in Fig. 3. to the positive bar which comes through the

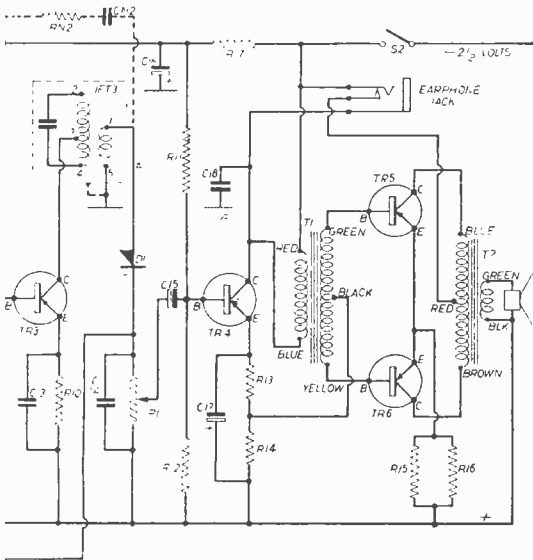
transformers and the loudspeaker has dried hard. T1 may be glued in place as shown in Fig. 2. there should be just enough room to place T1 on end in between IFT3 and the loudspeaker. The flying leads from T1 should face the loudspeaker. Care should be taken that the vanes of the tuning condenser are free to rotate when T1 is in place. To secure T1, a piece of copper wire about 24 s.w.g. is passed through the holes A and B in Fig. 3 and twisted around the frame of T1. the left-hand earthing tag on IFT3 can be soldered to this wire. Next the transistor holders for TR1, TR2, TR3 and TR4 can be glued in place. They should be a push fit in their slots. As the wiring on the top of the chassis must be as flat as possible, the four transistor holders must fit flush with the top of the chassis, so that the pins may be bent flat.

Battery Clip

Finally the battery clip is fixed into position next to the loudspeaker. To make the battery clip, a piece of 1/16in. Perspex 1 1/2in. X 1/2in. is cut. Two countersunk holes are drilled 1/16in. apart at each end. Two pieces of spring steel are used to hold the battery in place and these are screwed to the holes mentioned previously. This whole assembly is cemented with chloroform to the underside of the chassis, next to the loudspeaker.

The Case

The case shown in the photograph was made from cream and black 1/16in. Perspex. It is made in two halves with the wire handle holding the halves together. When the handle (which is also used as a stand) is removed, the back of the case comes away to give access to the battery and to the chassis components. For reasons of strength the front of the case is cemented to the chassis, so that once the case is completed to gain access to the wiring on the top of the chassis is impossible; but provided that all the solder joints have been properly made this should never be necessary.

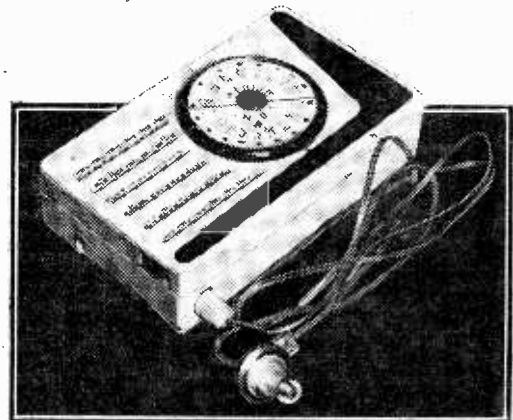


cut diagram.

chassis in the hole marked earth on the extreme right of Fig. 3. This bar which is 16 s.w.g. tinned copper wire is not, however, mounted at this stage. The next component to be mounted is T2 which is glued into place in the cut-out shown. The blue and black leads should face the edge of the chassis.

Transistors

The transistor holders for TR5 and TR6 are glued on top of the T2 with the contacts facing the edge of the chassis. Next the volume control is screwed on to the piece of 1/16in. Perspex as shown in Fig. 3. The volume control should protrude from the edge of the chassis by 3/16in. When the glue securing the I.F.



Showing the completed receiver.

Tuning condenser mounted by 3 countersunk screws. Cut $\frac{1}{16}$ " clear perspex to shape and glue to perspex chassis

Approx. shape of Wavechange switch cut from $\frac{1}{8}$ " perspex

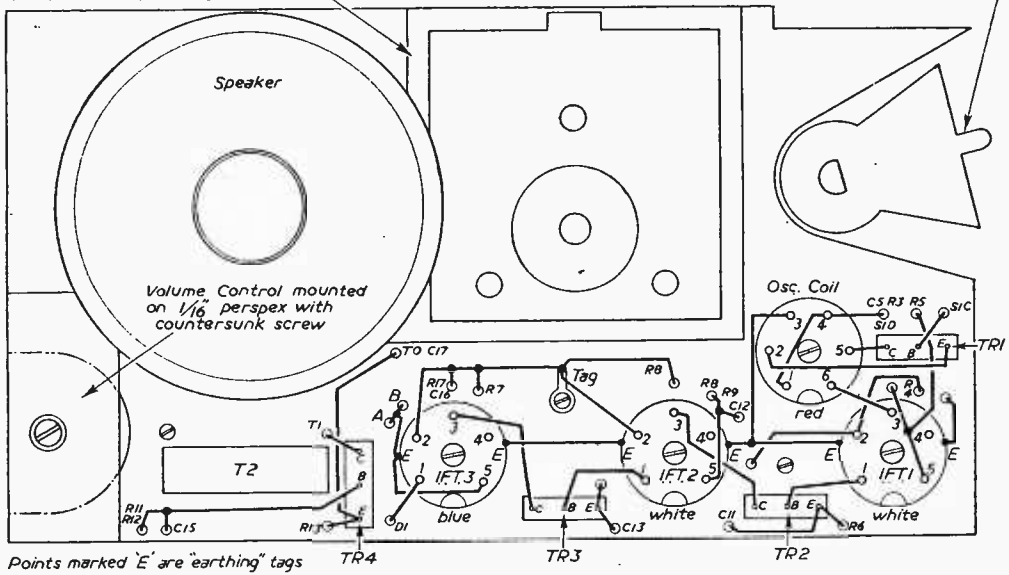


Fig. 3.—Top side of chassis showing wiring and approximate position of holes to be drilled for components. The wiring shown must not be more than 3/32 in. above the chassis.

Individual components can be replaced from the underneath. The reader will notice that a cut-away is provided for the volume control to be removed, should it be necessary.

neatly together the two ends of the case arc made of two laminations of 1/16in. Perspex. The decorative black Perspex inlets shown in the photograph are optional.

In order that the two halves of the case fit

(To be continued)

2-WAVEBAND POCKET SUPERHET COMPONENTS

- C1a—208 pF Jackson type 0.0 tuning condenser
- C1b—176 pF
- C2—50 pF (see text)
- C3—3 pF (see text)
- C4—.01 mfd. (Hunts Midget)
- C5—.01 mfd. (Hunts Midget)
- C6—2 pF (see text)
- C7—300 pF (close tolerance)
- C8—208 pF (see text)
- C9—8 mfd. (T.C.C. CE 69a)
- C10—2 mfd. (T.C.C. CE 58)
- C11—.1 mfd. (T.C.C. CE 68D)
- C12—.01 mfd. (Hunts Midget)
- C13—.1 mfd. (T.C.C. CE 68D)
- C14—.01 mfd. (Hunts Midget)
- C15—2 mfd. (T.C.C. CE 58)
- C16—32 mfd. 3 v. wkg. (A.C. 5700/32)
- C17—32 mfd. (T.C.C. CE 67)
- C18—.003 (Hunts Midget)
- CN1—56 pF
- CN2—27 pF
- R1—4.7 K
- R2—1 K
- R3—1 K
- R4—39 K
- R5—3.3 K
- R6—180 ohm
- R7—100 ohm
- R8—4.7 K
- R9—1 K
- R10—220 ohm
- R11—10 K
- R12—10 K
- R13—1 K
- R14—150 ohm (see text)
- R15—10 ohm
- R16—10 ohm
- R17—47 ohm
- RN1—1.2 K
- RN2—2.7 K
- VR1 } 5 K deaf aid
- S2 } volume control and
- switch (Ardente)

It may be possible to obtain the Jackson type 0.0 tuning condenser, complete with trimmers. This will greatly simplify the alignment instructions.

- TR1—OC44
- TR2—OC45
- TR3—OC45
- TR4—GT3
- TR5—GT3
- TR6—GT3

- GT13 B.T.H.
- GT12 B.T.H.
- GT12 B.T.H.

D1—Mullard OA70 or similar

S1—A, B, C, D, 4 Pole 2 way switch

6 transistor holders

Midget jack and jack plug—Fortiphone or Bulgin High impedance earpiece

If there is any difficulty in obtaining OC44 and OC45 the alternative types in brackets may be used. The Fortiphone jack and jack plug should be used in preference to the Bulgin type, as it is much smaller.

- L1, 2, 3—Oscillator coil (Wireless Telephone)
- IFT 1, 2, 3—I.F. transformer (Wireless Telephone)
- T1—Midget driver transformer (Belclere BN1826)
- T2—Midget output transformer (Belclere BN1827)
- AE1—Long-wave aerial coil (Wireless Telephone)
- AE2—Medium-wave aerial coil (see text)

Ferrite slab—Repanco— $\frac{3}{4}$ in. \times $\frac{1}{2}$ in. \times $4\frac{1}{16}$ in. (see text)

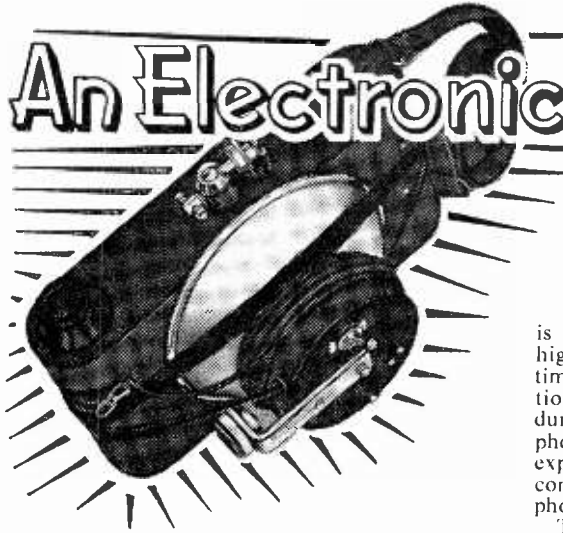
1 $\frac{1}{2}$ in. W.B. loudspeaker

Power supply TR132 Mallory 2.5 volt Mercury battery.

An Electronic Flash Unit

AN INEXPENSIVE EASILY CONSTRUCTED
100 JOULE UNIT

By H. Guy



THE assembly described in this article will equip its constructor with an electronic flash unit of one hundred joules capacity whose performance is at least equal to most manufactured units on the market of equivalent rating. The cost, however, is less than a third of the average for such an instrument, while its construction makes no demands whatsoever on either the electrical or mechanical aptitudes of the reader.

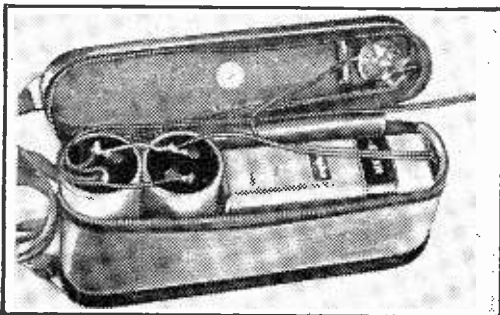
In fact, nothing more difficult than soldering is involved in the constructional process, the conventional chassis normally associated with electronic apparatus being dispensed with here.

The small number of components incorporated in the design are available ex-stock from the manufacturers listed and in addition some care has been exercised in ensuring that the quality of the goods leaves nothing to be desired, though the cost is at a minimum.

At the outset a brief description of the principles involved is helpful in understanding how the circuit has been designed.

Electronic Versus Bulb-type Flash

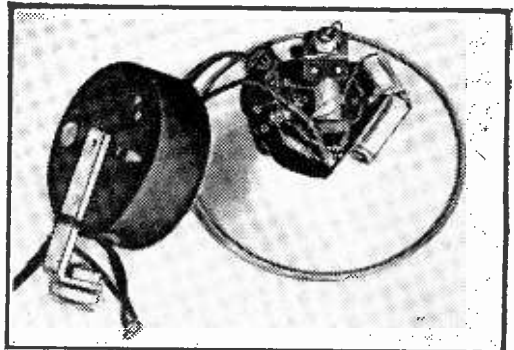
In bulb-type flash equipment an electric current



Typical battery box arrangement with electrolytic flash condensers and batteries in case and "off 50/100 joule" service in lid.

is used to ignite a fine magnesium wire which is highly incandescent for a very short period of time. The light energy thus generated, proportional both to the intensity of the flash and its duration, is converted to chemical energy at the photographic plate or film, and the correct exposure is thus obtained independently of the conditions of illumination of the scene being photographed.

The use of bulb photoflash equipment is obviously costly since the bulbs themselves are expendable items, and in the electronic solution to this problem, a gas discharge tube, whose life is many thousands of flashes, and hence many



The lamphead with cap removed showing the arrangement of components on the reflector assembly panel.

thousands of exposures, replaces the flash bulb.

These discharge tubes contain an inert gas, such as xenon which, when ionised, provides an extremely low resistance path to the flow of an electric current. If this current is derived from a high voltage source then a very large current will flow through the ionised gas producing a very high intensity of illumination for the duration of the flow, which in turn will be very short.

The required condition of high intensity for a short duration of time, representing the energy required to perform the chemical change on the plate, is met in practice by discharging a condenser through the flash tube.

Tube manufacturers rate the energy capacity of their tubes in watt-seconds or joules. This is a measure of the electrical energy that the particular tube will dissipate, and hence an indication of the type of exposure obtainable.

To some extent the calculation of aperture setting (f number) and subject distance for a given flash tube energy output and type of film is a rather arbitrary process, and some photographic circles quote another standard, the flash factor, in relation to film speeds, apertures and subject distance.

There is no hard and fast rule relating tube energy output to flash factors; the best correlation is obtained experimentally or by reference to the film stock manufacturers' literature.

Circuit Considerations

The circuit is designed around the Mazda FA10 flash tube which operates at the conveniently low voltage of 270v. This means that if a condenser of appropriate capacity is charged to 270v. and then discharged into the FA10 tube at the instant the camera shutter is operated, a light output corresponding to 100 joules is obtained.

The value of capacity C required for this light output is obtained from the formula which relates the energy available from a given capacity with the voltage V to which it is charged.

Energy in joules = $\frac{1}{2} CV^2$ where C is in μF . and V is in thousands of volts (kV).

Thus, for 100 joules output from a 270v. or 0.27kV. supply

$$100 = \frac{1}{2} C \times (0.27)^2$$

$$\text{and hence } C = \frac{200}{(0.27)^2} = 2750 \mu F \text{ approximately}$$

And, theoretically at least, for 50 joules output, a capacity of approximately 1,375 μF would be required.

In practice, two 1,000 μF electrolytic condensers are employed. A switch is included to enable the user to obtain either a nominal 50 joules output when only one of the condensers would be used, or a nominal 100 joules output when the switch would connect the two condensers in parallel to give 2,000 μF .

In this design the capacitors used are two Daly types PFX 63/18, 1,000 μF 270v. electrolytic.

At first sight the capacity values used may appear to fall far short of those required for the stated energy outputs, but in point of fact

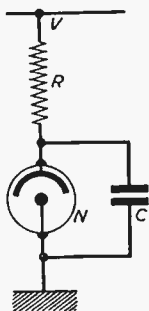


Fig. 1.—“Fully charged” indicator basic circuit.

the manufacturing tolerances on the condensers are “minus zero, plus 50 per cent.” This implies that a condenser stated to have a capacity of 1,000 μF may in fact have any value from 1,000 μF up to 1,500 μF , and on an average, therefore, the working energy capacity of the system will not be very much less than the calculated value in either instance.

This apparently wide tolerance is an unavoidable feature of the manufacturing process of electrolytic condensers, and since several other characteristics of the circuit also have a controlling influence on the net energy liberated as light from the gas tube, the condenser tolerance factor can be ignored.

When the flash occurs its duration will be approximately $2\frac{1}{2}$ thousandths of a second—

$2\frac{1}{2}$ millisees. To discharge the two condensers of total minimum capacity 2,000 μF in this time requires that the total circuit resistance, including the tube, shall be not much more than 1 ohm.

(It is interesting to note that with a total resistance of 1 ohm, the peak current that flows in the circuit during the flash interval will be about 270 amps.)

Consequently it is extremely important to keep the resistance of the leads between the condensers and the flash tube as low as possible. If this lead resistance is at all an appreciable fraction of the total circuit resistance, then this fraction of the 100 joules will be wasted as energy dissipated in leads and connections. Now plug and socket connections are one principal source of unnecessary circuit resistance and for this reason the customary plug and socket connection that normally provides a detachable link between the lamp head and the battery case in most manufactured units has been avoided here. Instead a direct twin flex is soldered between the condenser switch and flash-lamp base.

Power Supplies

The condenser charge must be provided in the first instance by some sort of power supply. Some manufactured designs use a rechargeable L.T. accumulator to drive a vibrator pack from which a H.T. voltage is derived to charge the condensers, while others, using the same basic technique, go one step further and replace the electro-mechanical vibrator with a transistorised vibrator. These solutions are costly, however, and the simplest approach is to provide a portable battery supply within the equipment.

The supply voltage of 270v. is conveniently made up of either three 90v. portable batteries or four 67½v. batteries.

The total current that can reasonably be drawn from these batteries is restricted to some tens of milliamps, and therefore in limiting the current to a safe average, some time must elapse during which the condenser acquires its charge. If this time interval between one shot and the next is made, say, 10 seconds, then the series charging resistance at a maximum will be about 4k. Allowing for the contribution to the resistance made by the internal resistance of the batteries, and for the fact that the condenser capacity is likely to be greater than 1,000 μF then a series charging resistance of 3.3k will be adequate.

“Fully Charged” Indicator

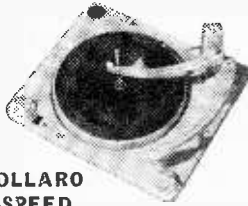
Some measure of the state of charge of the condenser is required to show the owner when the electronic flash unit is next ready for use. This may be provided by a neon flashing indicator, illustrated in its simplest circuit form in Fig. 1.

N is a neon lamp which for the sake of discussion is assumed to strike at about 200v., say. Once a neon lamp has struck it will continue to burn at a much lower voltage. At some minimum voltage, however, the neon will no longer continue to conduct and extinguishes. This voltage might be 150v. in this example.

The neon is connected in series with a resistance R and in parallel with a condenser C. Initially

(Continued on page 459)

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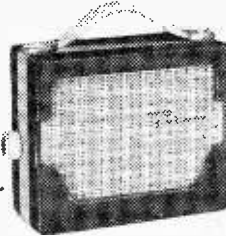
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condenser C is uncharged and the neon N is, of course, not conducting. As the supply voltage V rises to 200v, condenser C charges through the resistor R thus increasing the potential across the neon. When this potential has risen to 200v, the neon will strike, and condenser C starts to discharge through the neon lamp. This discharge will continue until the potential across the neon has fallen to 150v, at which level the neon current is no longer sustained and the neon extinguishes.

Condenser C is now once more free to charge towards the supply potential V and the cycle repeats. In consequence the repetitive action causes the neon to flash on and off at a steady rate, giving a visual indication of the readiness of the equipment for use.

In the final circuit a second resistance R is connected in parallel with C thus forming a voltage divider in conjunction with R so that until V has risen to its full value, the maximum potential to which C can charge is less than the necessary neon striking voltage. The flashing indication will not then be given until the two 1,000 μ F condensers have reached their full potential and hence not until the energy available is at a maximum.

The neon used in circuit is the CC3L which strikes at approximately 80v., and extinguishes at about 60v. Consequently the voltage divider (R4, R5 in Fig. 2) provides about + 80v. at the point to which the neon is connected when the electrolytic condensers have charged to 270v.

Another popular method of charge indication involves the use of a meter instead of a neon. Connected as a voltmeter across the two 1,000 μ F condensers, the fully charged indication is given directly as a voltage reading on the meter.

However, the present design considers only the neon type of indicator since it is cheaper and less bulky to install.

Triggering Supply

The voltage acquired by the electrolytic condensers is not in itself sufficient to cause conduction in the gas tube. This conduction must be initiated by ionisation of the gas using an external triggering supply, via a special triggering electrode within the tube. This triggering supply voltage is necessarily of a fairly high potential, about 3.5kv., and is derived from a triggering coil which operates on a principle similar to that of the ignition coil in a car electrical system.

The secondary winding of the triggering coil consists of many turns of wire and is connected between the tube triggering electrode and earth. The primary consists of comparatively few turns and is coupled via a condenser C3 and series limiting resistor R3 to the supply potential across the main electrolytic condensers. See Fig. 2.

C3 will charge up slowly through R3 to the supply potential and because this charging action

is not rapid, nothing significant in the way of a voltage is induced in the secondary of T, the triggering coil.

However, if switch S2 is closed, condenser C3 will discharge rapidly through the primary of transformer T to earth, and hence a very large instantaneous voltage is induced in the secondary. This voltage is sufficient to initiate the ionisation of gas molecules in the flash tube, thereby providing the conduction path for the heavy discharge current from the electrolytic condensers C1 and C2.

(To be continued)

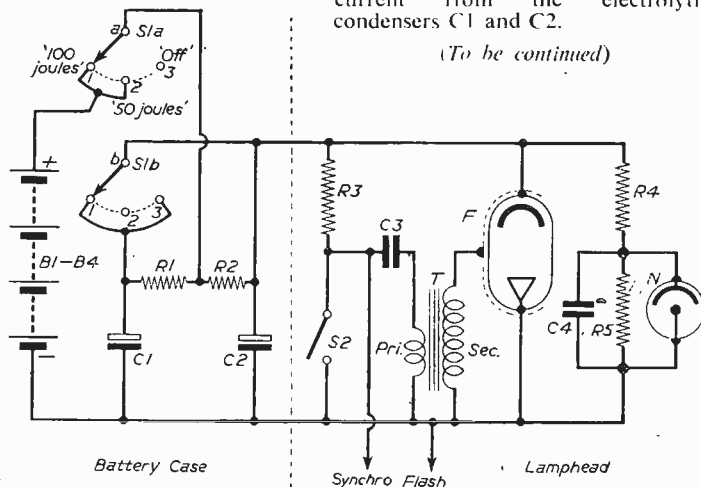


Fig. 2.—Complete circuit of electronic flash gun.

LIST OF COMPONENTS FOR THE CIRCUIT OF FIG. 2

B1-B4—Four 67.5 volt batteries (Ever Ready B101, Drydex DN539, or Vidor L5500).

or three 90 volt batteries (see text).

S1—2-pole 3-way rotary switch (Plessey type B).

S2—Lamphead test button.

N—Neon indicator type CC3L.

T—Triggering coil (General Electronics).

F—Mazda FA10 100-joule flash tube.

RESISTORS AND CONDENSERS

R1, R2—3.3K 3-watt wirewound resistor.

R3—330K $\frac{1}{2}$ -watt, 20% carbon resistor.

R4—2.2 M $\frac{1}{2}$ -watt, 10% carbon resistor.

R5—1 M $\frac{1}{2}$ -watt, 10% carbon resistor.

C1, C2—1,000 μ F, 270 v. D.C. working electrolytic condenser, Daly type PFX63/18.

C3—0.1 μ F 350 v. D.C. wkg. paper condenser.

C4—0.1 μ F 150 v. D.C. wkg. paper condenser.

LAMPHEAD ACCESSORIES

One reflector with component mounting panel.

One black crackle cup with mounting bracket and shoe and test flash button (S2).

MISCELLANEOUS

Press-stud battery terminals or appropriate battery plugs.

Perspex tube cover (General Electronics).

Camera synchro lead and plug (any camera dealer).

Leather (or other) battery case, 10in. x 2 $\frac{1}{2}$ in. x 5in. deep (see text).

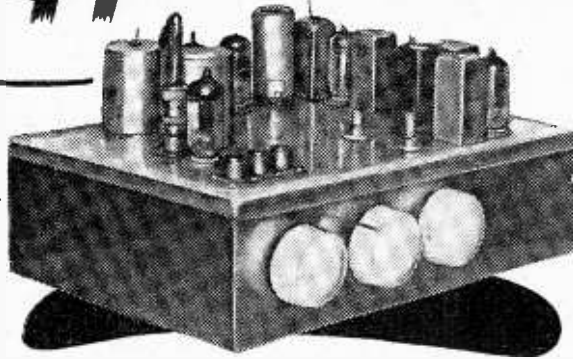
PVC connecting wire and flex, solder, etc.

Condensers C1 and C2 are supplied by Messrs. Daly (Condensers), Ltd., of Ealing, W.5, and the lamphead accessories and other components as indicated by Messrs. General Electronics, Portobello Road, W.11.

A Hi-Fi A.M. RECEIVER

It will be found necessary to use an extension spindle for this control: a suitable coupler will be found to be very cheap, and the extra length of spindle may well be left over from one of the other knob spindles which have been cut to size. On the prototype, a grommet was at first used to prevent friction between the knob spindle and chassis front plate, but was found to wear quickly. The system has been found to be satisfactory with a clearance hole drilled here, no support for the spindle being necessary.

As in the output chassis, a number of 6 B.A. screwed brass rods are used as bus-bars. The method of fixing them was shown in Fig. 6 (last month) and the material used for the support may be bakelite or cbronite, or any similar insulator. These bus-



How to Make a Self-contained High-quality Receiver, Using a Mullard 5-10 Amplifier for the Output Section. Full Cabinet Constructional Details are Given in This Issue.

By R. Couvela

(Continued from page 356, July issue)

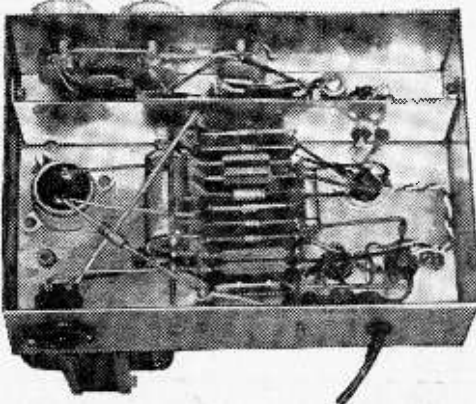
Construction of the Power Chassis

The power supply as specified uses no valves, so there is no necessity to use a metal chassis. For the prototype, the unit was built on a piece of 3/4 in. plywood. The heavy components were fixed with countersunk bolts, the heads being underneath, while the rest may be secured by round headed wood screws. The rectifiers should be mounted on angle brackets,

and the electrolytic capacitors may be laid horizontally to save space. Note that if the power supply circuit is modified to use either valve rectifiers or a single transformer, it will probably be found that there is not sufficient room available in the cabinet, which will have to be modified accordingly. In the event of valve rectifiers being used, the lower back panel of the cabinet will have to be perforated for ventilation. It will not be safe to allow this space to be left open if there are children or pets in the house, and, in the former case, it may well be advisable to cover the top section as well.

Construction of the Cabinet

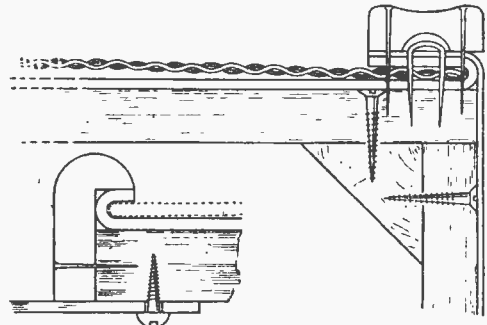
Figures 8 and 9 show clearly how the cabinet should be constructed. It is built almost



Underside view of the output unit.

bars are used for all connections in the I.F. strip, but not for A.F. circuits. The latter should be earthed near VII. The earth bus-bar is connected to chassis inside the frequency changer screened section.

Constructors might like to note the use of the electrolytic capacitor clips under the chassis, in order to provide a neater appearance than the conventional mounting above the chassis.



Figs. 10 (top), 11 (bottom).—Method of securing the grill to the front of the cabinet.

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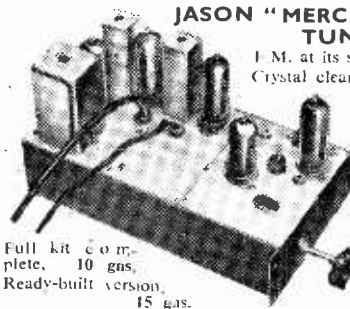
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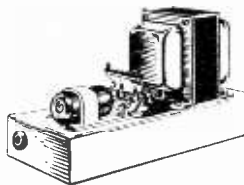


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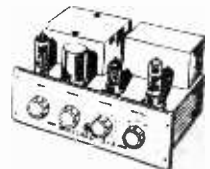
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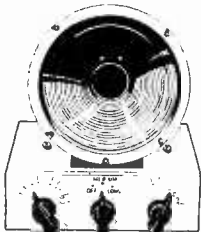
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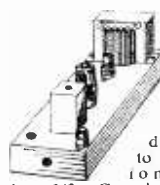
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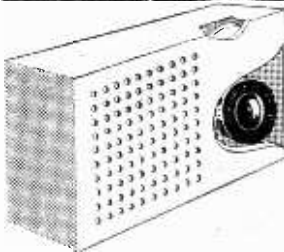
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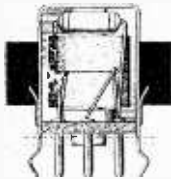
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Post 9d. Per valve.

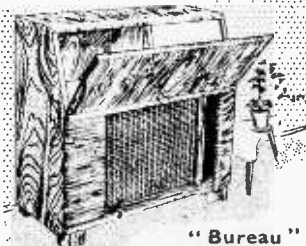
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exclusively of $\frac{1}{8}$ in. plywood, two sheets being glued together where a $\frac{1}{4}$ in. thickness is required.

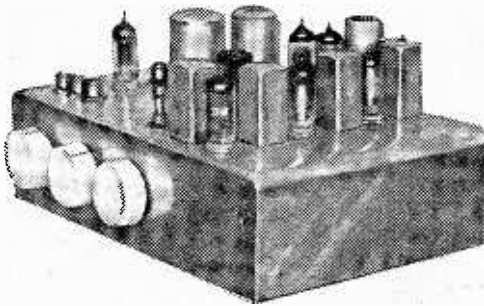
The joints are all made using a $\frac{1}{4}$ in. radius quarter-round section, which is first glued and then screwed from the outside. The drawings show this as a triangular section for simplicity. All joints of this and other beading must be mitred, and those constructors who have not already got a mitre are advised to make one from a 6 in. length of 1 in. channel iron. The task is not very difficult, and will be amply rewarded in the improved appearance of the receiver, not to mention future undertakings.

It will be found that by using the specified method of construction, the cabinet is easily built with even the simplest tool sets: all complicated jointing has been eliminated, whilst the result is attractive in appearance and of adequate strength. Care should be taken to ensure that all faces are firmly glued together, as well as being screwed, as this considerably reduces rattles, etc.

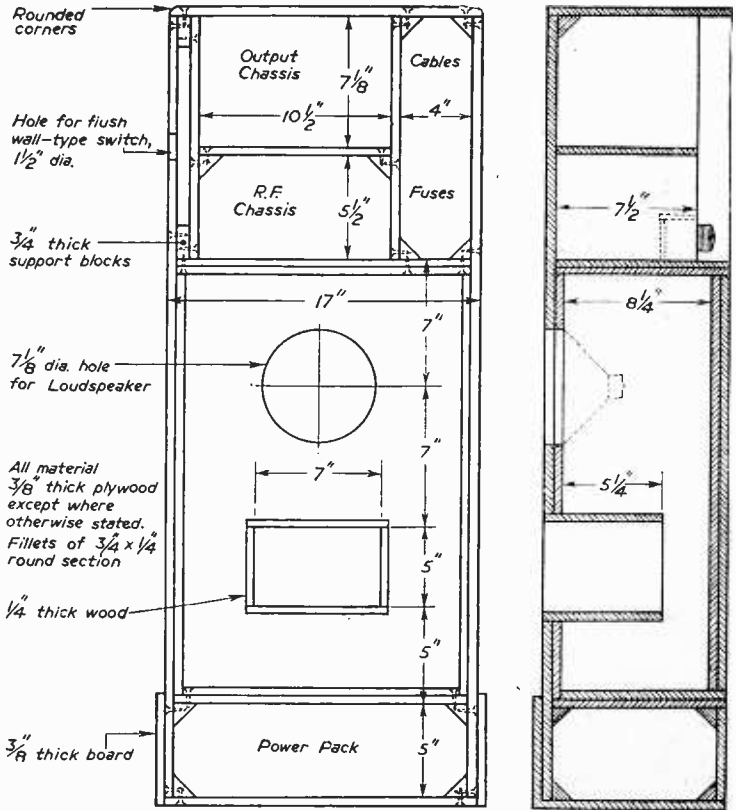
Many amateurs seem to find considerable difficulty in obtaining a satisfactory finish on their work so this process will be treated in detail.

The first problem arises with the covering of the front, and gold-painted expanded metal was chosen, as this provides a very effective finish, good protection for the speaker, and is reasonably easy to use. The danger arises in that the metal has a tendency to rattle against the wood, even when firmly fixed, and precautions against this should be carefully observed.

A great help in reducing this is by covering the wood surface with a piece of felt. This should be glued on all over, leaving about 1 $\frac{1}{2}$ in.



The feeder unit.



Figs. 8 (left), 9 (right).—Front and side view of the cabinet giving full constructional details.

loose all round the edges. Don't forget, however, to fit the bolts for the loudspeaker first. After gluing, the loudspeaker and bass reflex apertures should be cut from the felt, leaving $\frac{1}{4}$ in. free felt overhanging the edges of the holes. The knob panel aperture should then be cut, leaving $\frac{1}{2}$ in. overhanging.

The expanded metal grille should be cut to the size of the face of the cabinet, and the knob panel aperture should be cut. It should then be fitted in position, and lightly fixed with a staple at each corner. You may well find that you cannot obtain a piece of expanded metal of sufficient height, and the object of the "skirting board" at the bottom of the cabinet is to cover up this fact, as well as to give an added attraction to the design.

Next, the sides and top may be covered

Valve Base Connections

Valve	Base	1	2	3	4	5	6	7	8	9
X79	B9A	G2	4G1	k	h	h	Ah	Gt	& 3	At IC
W77, 6D6	B7C	G1k		h	h	A	G3	G2		
D77, 6AL5	B7G	k2	A1	h	h	k1	S	A2		
L77	B7G	A	IC	h	h	A	G	k		
QS 150 15	B7G	k	k	k	P*	A	A	A		

*Note: In QS 150 15, "P" indicates "Primer."

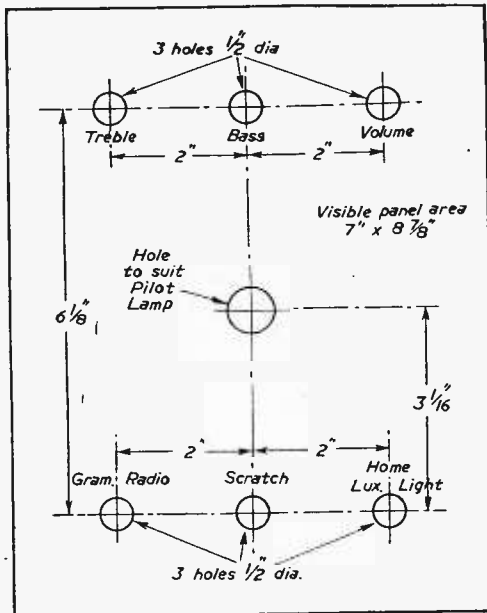


Fig. 12.—The measurement details of front panel.

with rexine or leatherette, which is available in a wide range of colours and quality. This should be carefully glued down all over, having made certain that all screwheads are truly flush with the face. About $1\frac{1}{2}$ in. should be allowed to project over the front and back of the cabinet. It should then be folded over at the back, and glued down. If it should be necessary to make a join, avoid doing it on a corner, as it will peel away from here in time. The two edges should be joined on a flat area, and should overlap. The lower one should be glued down first, and then sandpapered to provide a flat surface for the second layer, which should be carefully sandpapered underneath to make a smooth joint. Avoid permitting the glue to touch any surface of the rexine which will show, as the surface will be damaged.

Next, fold the rexine round the front with the protruding edge of the felt underneath it, and fix both these and the grill with $\frac{1}{2}$ in. wire staples; these should be inserted horizontally, i.e. the two points the same distance from the ground. Ensure that you don't hammer them in on top of the screws in the wood. The secret of ensuring completely vibration-free performance is to slightly bow the grille as you nail it on. This bow should not be very great, as if it is excessive the metal will buckle, but there should be $\frac{1}{4}$ in. clearance between felt and metal all round the speaker aperture.

When the grille has been fixed down, the frame beading may be added, being fixed with panel pins. This beading is easily obtained from any cabinet maker or builder: the type used on the prototype was intended for use as a covering for electric cables. The "skirting board" is fitted in a similar manner.

The knob panel should be fitted after the grille, otherwise damage might result to it. It is made of Formica, a piece of which will be found quite cheaply as an off-cut at a builder's. It was such a chance which governed the choice of colour on the prototype, and turned out very well: it is yellow with a brown grain.

The lettering was done with model aircraft transfers, which are available in alphabet sets: these were $\frac{3}{32}$ in. in dark blue. It will be found that the transfers will not stick to Formica, as the surface is too highly-polished. To overcome this difficulty, the panel should first be painted with a clear varnish, and another coat should be applied over the transfers.

With the knob panel in position, the knob panel frame beading is fitted. This is again fitted with panel pins, and there is no special difficulty involved, as long as it is ensured that the metal grille does not touch wood at any point.

The open woodwork should be stained with any liquid stain, and given a coat of shellac clear varnish. The whole of the outside may now be polished with ordinary furniture polish. The interior and back surfaces should be painted black, principally as an "insecticide." Black lines may be painted on the knobs if required.

The on/off switch is a normal wall-mounting flush type of light switch. A set of rubber feet should be fitted to the base of the cabinet.

Alignment of the Feeder Circuit

This section is devoted to the alignment of this receiver without the use of instruments.

It is a good idea to check up on the audio chassis first, so FS5 and FS6 should be removed: the tone controls should be set centrally, and the volume control to minimum.

Switch on, and check that pilot light and audio chassis heaters glow. Allow five minutes or so under observation for the circuit to settle down. Next, set the gramophone playing, ensuring that

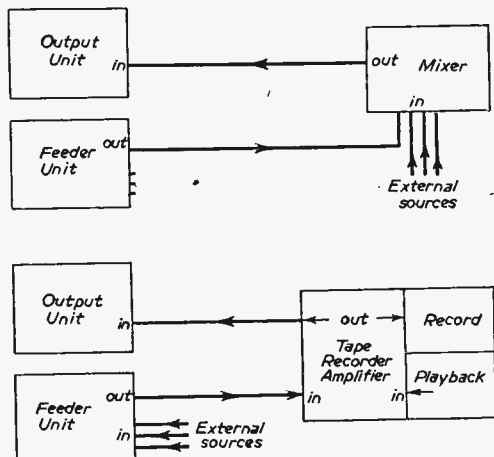
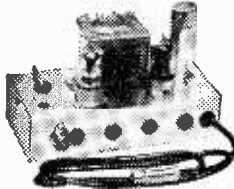


Fig. 13.—Use with tape recorder. A tape recorder may be used in conjunction with the unit to record any signal from the feeder unit. Note that public performance of material recorded from the radio is illegal.



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Volume Controls 80 ohm COAX
 Log. ratios, 10,000 ohms - 2 Megohms. Long spindle. 1 year guarantee. Midget Edison type.
 No Swr. D.P.Sw. 4.9
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200-250 v. A.C. Modern circuit with High Gain EL84 output and double wound Mains Transformer, variable tone and volume controls, wired and tested with 6in. Speaker and O/P Trans. complete with knobs and drilled ready to fit Baffle Board in above cabinet. Only £3.19.6. Carr. & Pack. 2/6.

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TYGAN FRET. - (Max. width 5 1/4 in.) 12 in. x 12 in., 2 - 12 x 16 in. 3 - 12 x 24 in., 4 - , etc.

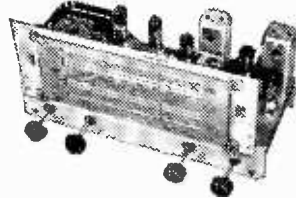
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1R5, 1R4 7 6	DK96	9 -	EP80	10 6	PCL83	12 6	
584, 3V3 8	DL96	9 -	EP86	10 6	PL81	14 6	
5Z4	8 6	5ZL6	10 6	EP91	8 6	PL82	10
6AT6	8 6	5AB8	9 6	EL41	10 6	PL83	11 6
6K7	6 6	EB91	6 6	EL84	11 6	PY80	8 6
6K8	8 6	EB41	10 6	EM85	11 6	PY81	9 6
6Q7	8 6	EC83	8 6	EY51	12 6	PY82	8 6
6SN7	8 6	EC84	12 6	EY86	14 6	PY83	10 6
6V6	7 6	EC86	12 6	IZ40	8 6	IZ2	8 6
6X4	7 6	EC92	12 6	IZ90	9 6	IZ5	12 6
6X5	7 6	EC42	10 6	EZ81	8 6	PC42	10 6
7C5	9 6	EC81	10 6	MC14	9 6	UP41	10
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100 25 v. T.C.C.	2	8 16 50 v. Hants		5
8 450 v. T.C.C.	2 3	16 450 v. T.C.C.		5 6
8 8 450 v. B.E.C.	4 6	32 350 v. B.E.C.		2
8 16 450 v. T.C.C.	5 32	32 275 v. Hants		4 6
16 500 v. B.E.C.	3 6	32 450 v. T.C.C.		6 6
16 500 v. Dub.	4	250 350 v. B.E.C.		6 8
16 16 450 v. T.C.C.	5 6	60 350 v. T.C.C.		6 8
32 500 v. B.E.C.	4	60 100 350 v. B.E.C.		11 3
32 500 v. Dub.	5	60 250 275 v. B.E.C.		12 6
50 1 350 v. B.E.C.	6 6	100 200 275 v. B.E.C.		12 3

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the gramophone output is connected directly to the output chassis, *not* via the feeder unit. Then increase RV1, when the signal should be audible. If this is not the case, check all external leads, i.e., power supply, gramophone supply and loud-speaker. If these are in order, then the normal routine for checking an audio amplifier should be followed.

When the output chassis is working satisfactorily, the mains supply should be switched off, and the fuses replaced. Then, VR48 should be adjusted to give maximum voltage on V10a cathode, a good aerial should be fitted (the set will not work without), the tuner switch should be set at the position for the most powerful station to be received, the output of the feeder should be connected to the output chassis, the audio frequency selector switch should be set at "RADIO," and VR49 should be set at minimum. RV1 should be left at a position which gave comfortable listening on "GRAM."

On switching on the mains supply, signal should be heard on adjusting VR49, after the usual warming-up period. It is not advisable to adjust any trimmers or coils unless a signal is audible, as these are set reasonably accurately by the factory, and any indiscriminate adjustment may create difficulties. If no signal is heard, and all external connections are good, try removing the aerial; if a sound is heard, then it is reasonable to assume that it is only the tuning at fault, and adjustments may be made to the appropriate oscillator trimmer only.

When signals are heard, adjust appropriate trimmers on the coilpack for optimum results, and then adjust I.F.T.1, I.F.T.2 and I.F.T.3, but not I.F.T.4. A non-magnetic screwdriver should be used, which may easily be made from a plastic knitting needle, size No. 10. On changing the tuning switch, I.F.T. slugs should not be re-adjusted, otherwise the tuning of the previous station will be wrong.

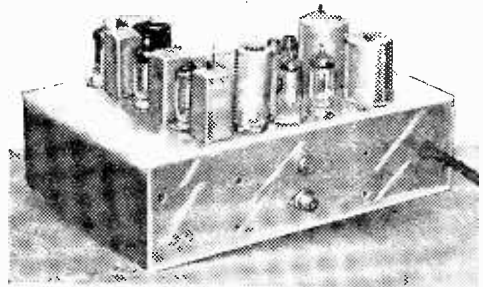
During the first hour or so, the tuning will not stay set, but will drift slowly. This is

perfectly normal, and the receiver will settle down after a short period of time. For optimum results, the set should be readjusted every week or so, until this becomes unnecessary.

Adjustment of A.V.C. Amplifier

The A.V.C. amplifier may be adjusted only after the rest of the set is giving satisfactory performance. First, VR48 should be reduced slowly; if the signal fades during this process, VR49 should be increased to restore it. This process should be repeated until either VR49 reaches its maximum value, or VR48 reaches minimum. Next, I.F.T.4 should be adjusted for *minimum* output in the loudspeaker; if this adjustment is indistinct, then no alteration should be made from the factory setting.

Next, reduce VR49 to minimum, and also RV1.



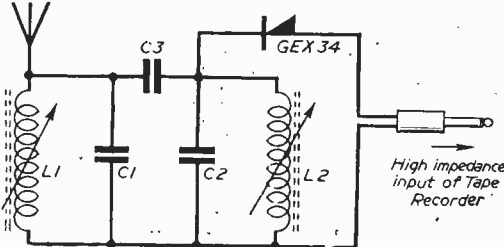
Rear view of the feeder unit.

Switch to "GRAM," and set the gramophone playing; then adjust RV1 until volume is at normal listening level. Switch to "RADIO," and adjust VR49 until volume is at normal level. This is the correct setting for all controls.

If it should be found that the last adjustment takes VR49 to maximum, then it should be left there, and RV1 adjusted for comfortable listening. Then a resistor should be fitted in series with the gramophone input to reduce the level to that of the radio signal.

**MAKING A RADIO JACK
An amendment to the circuit**

IN the article on Making a Radio Jack, which appeared on page 357 of our July issue, a draughtsman's error occurred in the circuit diagram Fig. 1. C2 was shown connected direct to the crystal diode GEX34. It should, of course, also go to C3 and L2 as shown in the corrected diagram below. The wiring diagram Fig. 3 is correct.



The corrected circuit diagram for the radio jack described in the July issue.

**PRACTICAL TELEVISION JULY ISSUE
NOW ON SALE PRICE 1/3**

The current issue of our companion journal PRACTICAL TELEVISION, which is now on sale, contains details of some interesting receivers of French design. Also there is a practical article on alignment procedure.

In addition, ITV in difficult areas is dealt with by some practical hints on coping with reception from the viewer's point of view. The construction of a 600 Mc/s oscillator for Band V is also described. An aerial that is becoming increasingly popular in amateur transmitting circles is the cubical quad aerial, and this is fully dealt with.

The main constructional feature is further details of a Pattern Generator, which is ideal not only for the serviceman, but also for those interested in experimental and development work.

The issue also contains the regular features: Servicing Television Receivers, Problems Solved, Underneath the Dipole, Correspondence, etc.

A Full Compass ELECTRIC ORGAN—1

CONVERTED FROM A
PIANO-ACCORDION

By R. Woodcock

THERE must be a large number of readers who, like myself, have been intrigued with the idea of building a full compass electric organ and who although possessing the necessary technical ability are somewhat overawed by the thought of the enormous amount of "donkey work" involved. Having played the piano-accordion for a number of years, I decided to explore the possibilities of converting this to an electric organ. Initial experiments proved the idea to be so successful that a complete organ has now been built. It has been played at several social functions, with complete satisfaction.

Very briefly the system of operation is as follows. The treble and base portions of the accordion are fastened side by side on the front of an air-tight wooden box. This can be seen in Fig. 1 (a). Due to the fact that the angle between the piano keys and the body of an accordion is more than 90 deg. it is, of course, necessary to slope the panel on to which the

treble half is mounted. In order, however, to give the box a symmetrical appearance, a false front is fitted and this is in turn used to mount various pieces of the equipment which will be described later. Inside the box and behind the bass unit is mounted the fan which provides the necessary suction to operate the reeds, the notes from which are picked up by microphones; a crystal microphone being used for the treble and a moving coil for the bass.

The outputs from the microphones are fed into a pre-amplifier mounted immediately behind the treble unit which provides the necessary tone-changing and vibrato circuits and from there to the main amplifier and loud-speaker.

Whilst it would, of course, be very easy to give a detailed account of the construction of this instrument, I feel that there are so many different sizes of accordion and so many possible variations of design, that it is better to give a description of the basic design principles of the various sections so that any reader wishing to make an instrument of this type will be able to decide whether or not such equipment as he may have to hand will be suitable. The design points of the various sections will therefore now be considered.

The Accordion

There are two types of tuning commonly used in accordions, "straight" and (Continued on page 471)

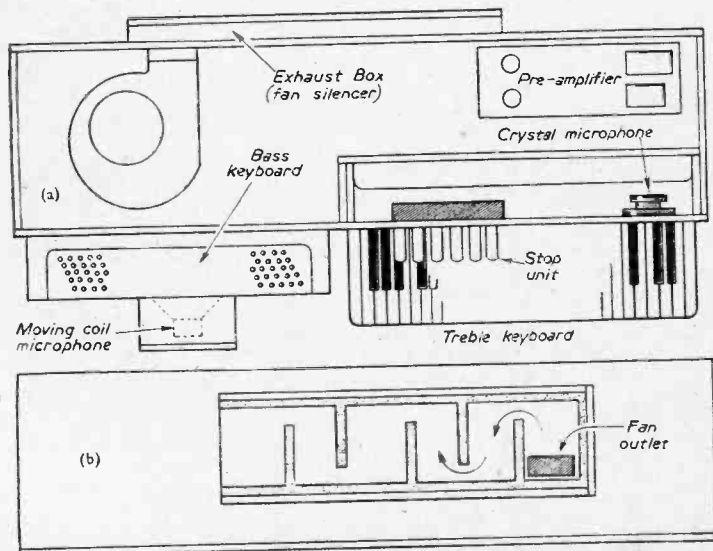
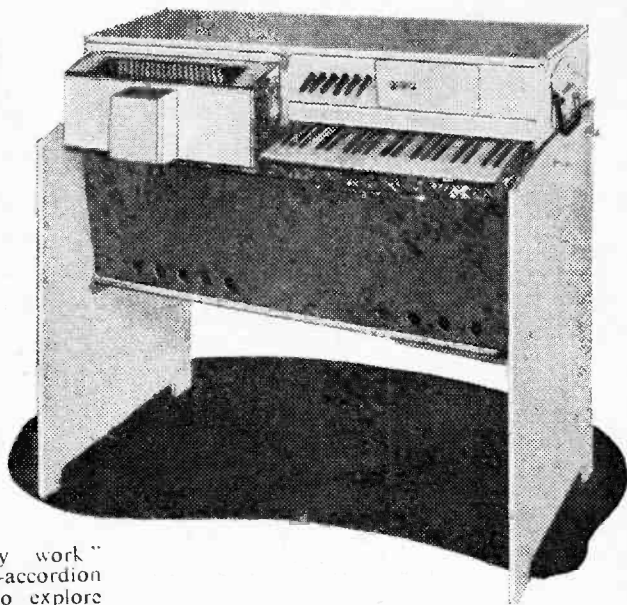


Fig. 1.—(a) Plan view with the lid removed. (b) Rear view showing fan silencer with top removed.

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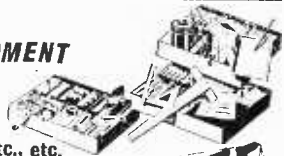
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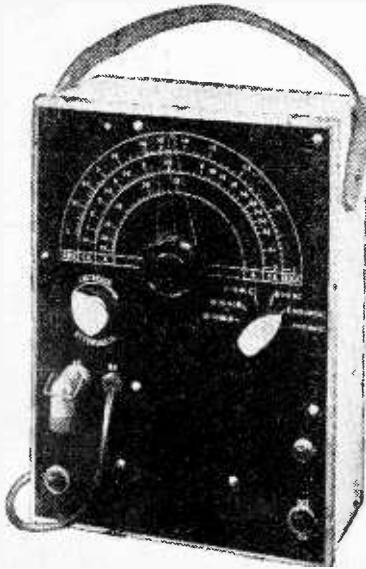
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"tremolo." The latter are fitted with two sets of reeds slightly mistuned so as to produce the characteristic waver, and if an instrument of this type is to be used it will be necessary to blank out one set of reeds. The accordion used in this particular organ was of this type and the interaction of the tremolo waver with the electronically applied vibrato caused something akin to a rumba rhythm to appear when playing certain combinations of notes! Blanking out one set of reeds, however, by sticking a strip of Cellophane tape across the holes in the bottom of the reed chest caused this effect to disappear completely. A word about the tone of the reeds is now necessary.

is capable of supplying very much more air than we need but small gaps can give rise to very unpleasant hissing noises. It is, however, fairly easy to seal these after final assembly with Cellophane tape. On most accordions the bass and treble units are fastened to flanges on the ends of the bellows by straight pins and if flanges equal in size to those on the bellows are used, exactly the same fixing can be employed.

The Fan

There are a number of different types of fan which can be used but whichever type is used, it is essential that it is capable of producing a

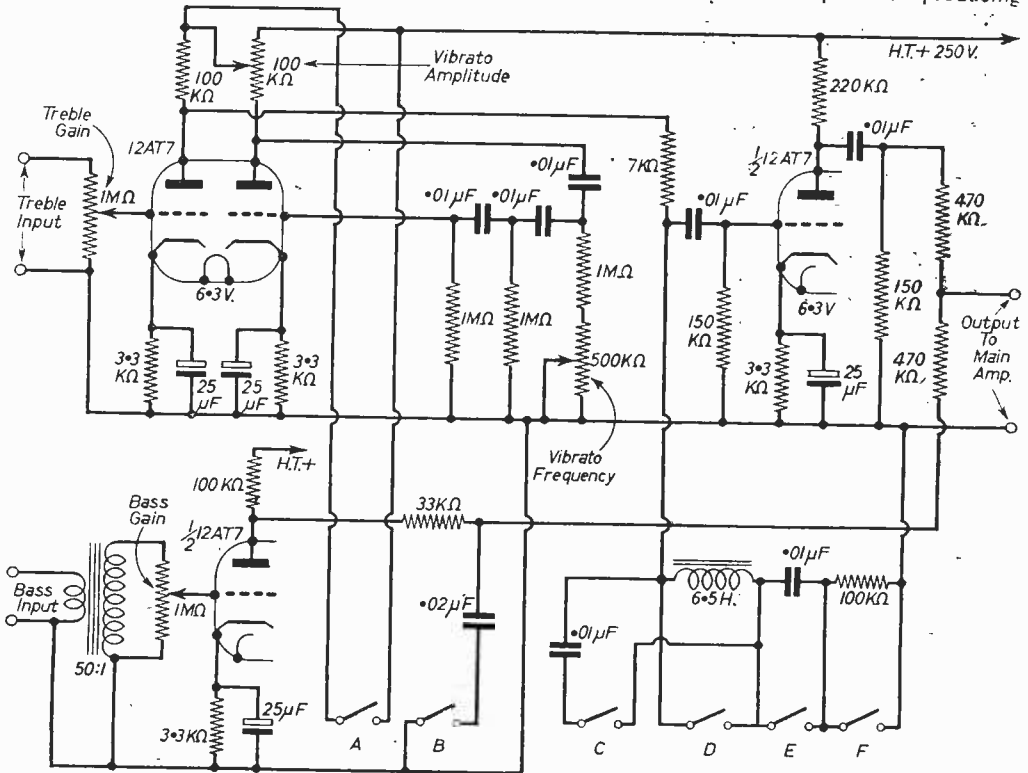


Fig. 2.—Circuit diagram of vibrato and tone unit.

Whereas on some of the more expensive accordions, the reeds produce a very mellow tone, the somewhat "harsh" tone of the cheaper variety is more use to us, as a "harsh" toned reed produces, of course, very many more of the higher harmonics, which in turn enables us to produce a greater variety of tone colours in the electronic circuitry. The ideal is to use a full-size accordion with 120 bass stops and a three-octave piano keyboard with at least one octave coupler, although no doubt the smaller varieties of accordion could be used to make quite a versatile instrument. Both the bass and treble units should be firmly fixed into the box (which in this case was of 1/2 in. plywood) and the joints made as airtight as possible. Absolute "airtightness" is not strictly necessary as the fan

vacuum of at least 1 1/2 in. water gauge. (This in non-technical language means that if a rubber tube inserted into a piece of cardboard, which is blanking off the fan intake, has its other end dipped into a bowl of water, the water will be sucked 1 1/2 in. up the tube.) Slightly less pressures than this will still operate most accordion reeds but result in a somewhat sluggish reed action especially in the bass section and also produce rather a dull tone. In order that the fan pressure does not drop too much when a large number of notes are played simultaneously, it must be capable of supplying about 10 cubic feet of air per minute. As most fans designed for pressures of this order will supply more air than we require, this does not present any problem.

(to be continued)

TRANSMITTING TOPICS

MULTIBAND ADAPTATIONS FOR THE SIMPLE TRANSMITTER

By O. J. Russell, B.Sc.(Hons.), G3BHJ



HAVING added a P.A. stage, the user of a simple crystal controlled type of transmitter will soon wish for multiband operation. True with fundamental crystals for, say, 1.8, 3.5 and 7.0 Mc/s. "three band" operation is possible. However, "one crystal-one band" is not a very satisfying prospect, and multiband operation is liable to be expensive in crystals. Moreover higher frequency operation presents a problem. Twenty metre crystals are not unknown, but they are expensive, fragile and easily damaged by

capacitor. This assumes of course that the 7 Mc/s tank coil has been adjusted to tune with a reasonable amount of "in circuit" capacity, say, 100 to 120 pFs. Such a value of tuning capacity is in fact a good one to use for the average 7 Mc/s 807 tank capacity. To check whether the tank circuit constants permit "doubling" in this manner, replace the aerial tuner by the faithful "lamp load" consisting of a suitable lamp bulb and a one or two turn coupling coil tightly coupled to the P.A. tank coil. Switch on, preferably with the H.T. line to the P.A. "protected" by a safety resistor of some 2 to 5K in series with it. Rapidly swing the P.A. tuning to the minimum position and search for a tuning dip and signs of R.F. lighting the bulb.

Generally the "dip" in the doubling position will be less sharp than that for fundamental operation. Also the anode current taken by the P.A. will tend to be higher, although efficiency and output will be smaller than when operating as a plain amplifier. A somewhat higher value of gridleak may improve efficiency when doubling, and somewhat heavier drive from the crystal oscillator will also help. Reasonable R.F. output will be obtained without resort to excessive drive, and a conservative efficiency of, say, 30 per cent. should be assumed for the "power doubler" operation of a P.A. stage. Thus with, say, 50 watts input to the P.A. stage, R.F. equivalent to a straightforward P.A. running 25 watts may be assumed. This output is enough for respectable DX working, and as it is achieved at the cost of no alteration to the transmitter is well worth the lowered efficiency.

Note that "power doubler" operation of the

(Continued on page 475)

Fig. 1.—The Tritet oscillator was at one time the popular method of directly obtaining harmonic output from a crystal oscillator. The cathode tuned circuit should not be tuned to the crystal frequency. A low power bulb in series with the crystal gives an indication of crystal current.

excessive feedback that would be cheerfully tolerated by a 7.0 Mc/s crystal. Some other solution is necessary, particularly as DX operation is much easier on the higher frequency bands. This despite the large amount of DX workable on 7 Mc/s, and even on 3.5 Mc/s. However, DX on these bands is very much of a "late night" kind, whereas on the higher frequency bands DX may be worked during most of the day with band selection available at the transmitter.

Doubling the P.A. Stage

The first measure that may be taken for extending the number of bands workable from a single crystal, is to "double" in the P.A. stage. With an 807 pF driven by a crystal oscillator, respectable outputs may be obtained, sufficient in fact to provide adequate DX operation. Generally a 7 Mc/s P.A. stage equipped with a 100 pF or better a 160 pF anode tuning condenser will tune also to the crystal second harmonic at or near the minimum of the tuning

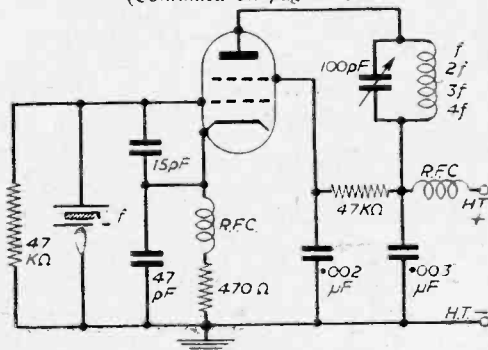


Fig. 2.—A modern version of the Tritet type of oscillator. Only very well shielded types of valves are safe in this circuit. The only common type which is successful is the 6AG7.

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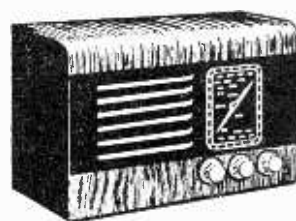


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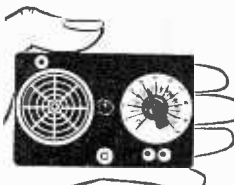
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While there is a limit to the DX bands available by exploiting the possibility of "doubling in the P.A.," it is by no means the final step. Familiarity with the ease of obtaining a little extra DX performance by such means soon leads to a few more tricks. The first thing is to use the P.A. as a straight amplifier. This is desirable, as with the low efficiency when doubling, the popular 807 is limited to a safe outside maximum of 45 watts, and a safer limit of 40 watts. These inputs in turn are only equivalent in output to straight amplifiers running at 20 to 22.5 watts input, and as a straight amplifier the 807 can run comfortably at 50 watts, and as a C.W. amplifier has a maximum input of 75 watts.

The Tritet

The "tritret" crystal oscillator directly producing harmonic frequencies, was at one time a popular method of obtaining multiband operation (Fig. 1). Oscillators of this type can directly produce second, third and even fourth harmonic power output if the anode circuit is tuned to the harmonic frequency. The cathode circuit resonates to a frequency a little lower than the second harmonic for doubling, and may be adjusted also for optimum output on the higher harmonics. However, crystal current may run high with such oscillators, and tuning the cathode near to the fundamental may result in crystal fracture. Furthermore, tuning the anode to the

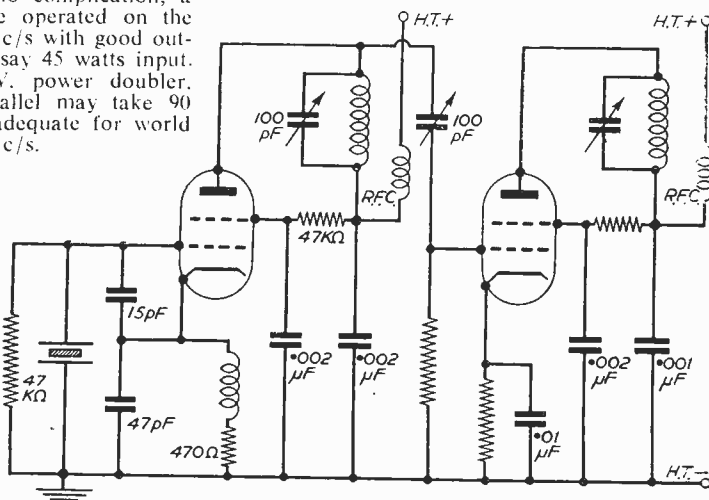


Fig. 3.—The "Harmonic Oscillator" may drive a further multiplier stage or a low power P.A. stage for a simple multiband transmitter.

fundamental generally fractured the crystal. Thus a switch to remove the cathode circuit from the R.F. circuitry is advisable if tritret modification of the simple crystal driving oscillator is attempted.

With the usual 6V6 or 6L6 oscillator tubes, only doubling and possibly tripling is recommended. With care low crystal current and adequate output to drive a single 807 as a straightforward amplifier should be obtained. A low-consumption bulb in series with the crystal should be used to prevent excessive crystal current; a 40 milliamp bulb as sold for certain cycle dynamo lighting kits is suitable. Moreover, the H.T. applied to the oscillator should be the minimum for good drive to the P.A. stage.

The Modern Tritet

A more modern version of the tritret style of oscillator is shown in Fig. 2. Here again with the usual oscillator tubes, tuning the anode to the fundamental will result in crystal fracture. A very well-shielded type of oscillator tube may be used and in such cases the circuit will operate with the anode tuned to fundamental as well as to the second, third or fourth harmonic. However, the 6AG7 is about the only tube which will

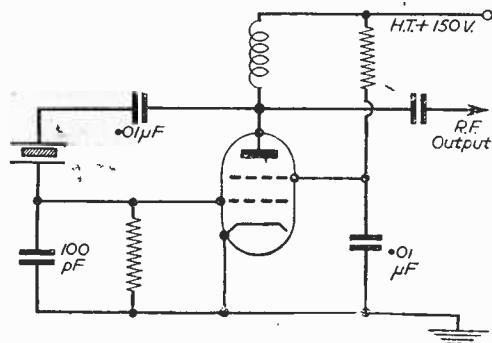


Fig. 4.—The Pierce oscillator which requires no tuning circuit, thus simplifying multiband rigs. Only the minimum H.T. for satisfactory operation should be used to avoid crystal fracture: A 6V6 is a satisfactory oscillator in this circuit.

operate with low crystal current and safe operation in this circuit. Despite these snags, the writer has used circuits of this type to directly drive a 10 metre 807 P.A. stage from a 7 Mc/s crystal.

Despite the attractions of "oscillator multiplier" circuits giving harmonic output directly in the crystal oscillator stage, a more straightforward approach is to use a separate multiplier stage. By using the Pierce oscillator circuit of Fig. 4, only two tuning controls need be used in a "multiband" TX of the type shown in Fig. 5. If a 6L6 buffer-multiplier is driven from a 6V6 in the Pierce oscillator circuit, then a 7 Mc/s crystal will give P.A. output on 7, 14, 21 and 28 Mc/s. Note the following points, however. Firstly, the Pierce oscillator should be run at the lowest voltage possible, as the crystal is subjected to the full R.F. voltage developed by the oscillator tube. Thus, 150 volts or 200 maximum should not be exceeded. For 7 Mc/s operation a tuned circuit is unlikely to be necessary in the 6L6 anode and, in fact, would probably cause instability troubles. A "damped" anode load consisting of an R.F. choke shunted by a 4.7 K resistor, or a 4.7 K resistor of 15 watts rating should be used as the 6L6 anode load for 7 Mc/s. For 14 Mc/s operation a conventional tuned circuit is switched in, and for 21 and 28 Mc/s operation it is possible to use one tuned circuit which may be tuned to 28 Mc/s at near minimum tuning capacity and to 21 with more tuning capacity. A 50 pF condenser should be adequate for tuning the buffer anode circuit.

With such a three-stage transmitter it should be possible to get good R.F. on all bands from 7 to 28 Mc/s. The output of the P.A. as well as the grid current developed may vary considerably from band to band. In some cases on 10 metres it may be found better to set the multiplier stage to 20 metres, and double in the P.A. to 10 metres. However, with care the 6L6 multiplier stage

should give adequate 10 metre drive, and the experimenter will find that improved layout and care over stray capacities will make a vast improvement to the 10 metre efficiency. Don't forget also that 10.5 Mc/s surplus crystals will give very good 21 Mc/s output, and that "odd" frequencies in the 4.7 Mc/s region will drive the 6L6 as a tripler for operation in the 14 Mc/s band. The Pierce crystal oscillator circuit shown will oscillate, of course, with crystals from 1.8 Mc/s upwards, as it has no tuning control.

The P.A. tuning constants will, of course, need alteration to suit the frequency band covered. If plug-in coils are used, appropriate coils for the four bands, 7, 14, 21 and 28 Mc/s, may be plugged in. To save "specifying" the coil size the P.A. tank coils should be adjusted so as to resonate with the "correct" in circuit capacity for the 807 under average operating conditions. Thus, on 40 metres 80 to 100 pFs of "in-circuit" capacity is needed. The value of capacity provided by the tank capacitor may be estimated accurately from the degree of mesh of the vanes. Remember also that on the H.F. bands the 10 pF or so of the 807 needs to be allowed for as this capacity, plus inevitable strays, are added to the capacity "in circuit" from the tuning capacitor. Thus on 40 metres one would adjust the anode tank inductance so that between 80 to 100 pFs capacity were provided by the tank tuning capacitor. On 20 metres the tank capacitor should tune with about 45 pFs of tank condenser capacity. On 21 Mc/s the anode capacitor should tune with a capacity setting of around 20 pFs, and 10 pFs for 10 metres. If the tank coils are adjusted to resonate with tuning capacities of these approximate values, then the L/C ratio of the tank circuits will be around optimum for one 807. If a pair of 807s in parallel are used, then these values may be doubled. The practical arrangement of the final P.A. stage is left to the experimenter.

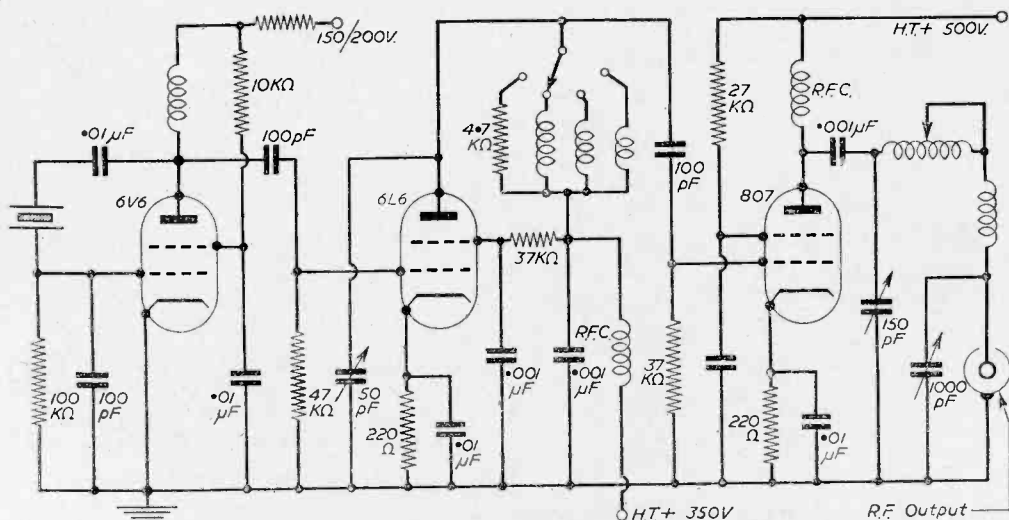



Fig. 5.—With a Pierce oscillator a single crystal in a simple transmitter may provide R.F. output on several bands. At a pinch one may operate the final stage as a double.

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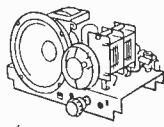
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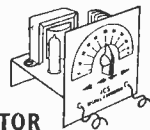


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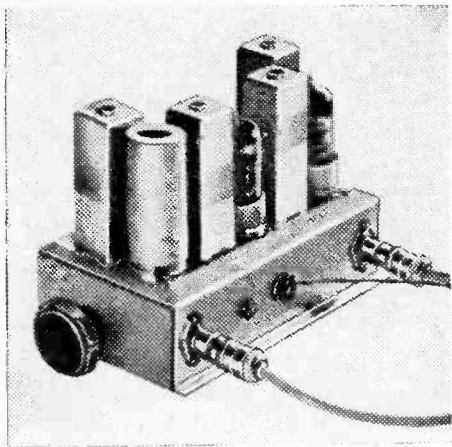
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Reeve, Reviews Some
Recent Programmes

CAVALIERS and Roundheads form as integral a part of the English scene as cowboys and sheriffs—and Red Indians of the American. Clive Brook's son was the author of a good play of the genre, "Lustre in the Dark," with Prince Rupert as the central character. It was breezily acted by Eric Anderson, Howieson Cullif, Malcolm Hayes, Cecile Chevreau and others. Producer, Peter Watts.

David Oistrakh is a violinist whose name one can conjure with these days. Russian, of course. His style, both technical and interpretative, is as entirely different from the generation of Kreisler as H-bombs are from tanks and artillery. He played the Brahms concerto from the Maida Vale studio in flawless and polished style. Its very efficiency hid a warmth which was probably there, but was not allowed to obtrude too much.

Desert Island Discs

Desert Island Discs took a novel turn one day when host turned guest and Roy Plumley was interviewed by Eamonn Andrews. In fact, he was hoist on his own petard, the seagulls mocked him and the sand got in his eyes for a change. Perhaps a similar change of roles could be worked out in some other programmes with entertainment value for the listener.

Opera

Opera on "blind" radio has always been chastised by the more highbrow critic, at least studio productions have. The idea of blacking out the visual impact of something so tremendous and engaging is rather like travelling through Italy or Switzerland with the carriage blinds drawn and just a guide reciting the features of the landscape. The Covent Garden production of Verdi's *Don Carlos* was unanimously hailed by the press as the most splendid spectacle seen there in decades. So all the "third" transmission could give us of it was the music and its performance. It was quite enough to make an enthralling evening—for those who could rise to the occasion. Tito Gobbi, Fedora Barbiera and the others were in splendid form, and the Covent Garden Orchestra under Giulini, put the luscious music over magnificently.

The Huggetts

Jack Warner has long been one of the BBC's foremost personalities, and rightly. He has what so few possess, the gift of putting ourselves in front of ourselves, of making the Joe Huggetts among us, for example, think they are listening to, and confronting each other. As Joe, in *Meet the Huggetts*, Jack sublimes tens of thousands of us, and keep us fully aware of the truth of Burns' immortal lines: "O wad some Pow'r the giftie gie us, To see oursels as others see us!"

He is supported by an admirable cast. Kathleen Harrison as his wife, George Howell as Bobby, Cynthia Bizeray as Jane and Chas. Leno as Fred Siebbings, all contribute to its gaiety and charm. Eddie Maguire's script and Jacques Brown's production are each admirable. John Cazabon and Warren Mitchell also add their quota of enjoyment.

Covent Garden

The Royal Opera House, Covent Garden. Could any other theatre in London conjure up such memories of great music, great art, and the great occasion? Drury Lane and the Haymarket would, of course, in their own special provinces. But for a microcosm all its own, a world unique in its combination of diversity in unity, Covent Garden must take precedence.

It certainly has the material within its walls for some wonderful broadcasts. Harold Rosenthal, a suave and knowledgeable commentator, gave a very good one of music and memories. He used vocalists, alive and on discs, interspersed with talk, with telling effect. And the programme was effectively introduced by "a galleryite" producer, Michael Bell.

France

A charming series, on network three, is *The French on the French*, in which French speakers in their own language answer listeners' questions about France and the French people. Difficult bits are translated and answers summarised in English so as to keep the lesson on a reasonably elementary level. The translator, Henri Appia, of the Lycée Henri IV, etc., does this with delightful charm and naivety. The whole thing is more like a play than a lesson, with quotations used as practice in phrase-making.

The Clerk's Story

Is a full-length play built round a storyteller a completely satisfactory affair? Is it, in fact, a play at all? A re-hearing of N. C. Hunter's *The Clerk's Story*—the first of last winter's series specially commissioned for radio—posed this question. It can have telling effect in a half-hour serial episode at weekly intervals, when the threads need tying together by such a device. But in one unit of an hour-and-a-half's duration it only seems to clog the movement and retard the action. *The Clerk's Story* was a very good play; it would have been interesting to hear it based entirely on character dialogue.

Open to Discussion



The Editor does not necessarily agree with opinions expressed by his correspondents

A Pat for Thermion

SIR.—May I congratulate you on Thermion's page? It is the first page to which I turn, and having read this provocative writer for several years I congratulate him also upon his forthrightness and fearlessness and upon your courage in permitting him to express his views. I agree with his views more often than otherwise, but the things he has to say need to be said. I am, for example, wholeheartedly with him in his attacks on the religious programmes put out for six nights a week by Radio Luxembourg. This sickly, nauseating stuff is enough to make one vomit! I understand that some of these sermonizers have not had any training in theology and are not qualified parsons. Some of them are just spouters of prepared scripts, just plain money-making concerns. I have sent for much of the literature that they offer free of charge, perhaps to justify their appeal for subscriptions and gifts and offerings. It would be interesting to examine balance sheets of some of these organisations to see where the money comes from, where it goes and how much of it is spent on spreading the gospel. Much of it is ranting nonsense and quite contradictory. There are about 20 of these broadcasts going on every week.—A. H. (Stepney).

P.W. Service Data

SIR.—Before the war when you described the construction of a receiver you published data sheets concerning each so that readers could take various current, voltage and resistance readings. You have discontinued this practice which personally I found most valuable. Would it not be possible to reintroduce it?—R. C. (Dorchester).
[Readers' views invited.—Ed.]

High Quality A.M. Receiver

SIR.—With reference to my article, A High Quality A.M. Radio Receiver, published in your June issue, I would like to draw your attention to a slip in your caption to one of the photographs on page 290. This caption states that the section of the circuit shown in Fig. 1(b) is included in the output section of the receiver, whereas, in fact, the whole of Fig. 1, parts (a) and (b), is included in the feeder section of the set. I regret that in the drawing of the circuit diagram I omitted to show a capacitor, which should be connected from the junction of IFT4

and V10 anode to earth. Its value should be 0.01 μ F, 250 V.W.—R. COUVELA (Earlsdon).

Those Shacks

SIR.—Thermion recently published readers' reasons for building themselves a radio shack. I built mine for two reasons—firstly for peace. My wife was always complaining about me using the dining-room table or the kitchen table; and secondly to avoid the trifling chatter of the women folk. I got sick and tired when I arrived home to hear a running commentary, on the lines of Mrs. Dale's Diary, on such trifles as: the milkman only left half a pint; little Johnny tore his pants; Mrs. Brown's husband doesn't play about with radio all the time; he takes her out in the car. We haven't a car but we could have if you hadn't spent your money on radio parts! Radio is my hobby and I like to be alone with it, free from interruption.—B. H. (Yarmouth).

Midget Radio Sets

SIR.—I have just read your editorial in the May issue about midget radio sets, and the possibility of having transistorised printed circuits produced. I for one am entirely in favour of this, as long as overseas readers will have stocks reserved so that they might order without the local readers taking up the quota. I am, therefore, in wholehearted agreement with your proposed project and I will certainly place an order for one when they become available.—PETER G. FLEMING (Jo'burg).

Meter Protection

SIR.—In reply to Mr. J. Brown's comments regarding my letter on meter protection published in the June PRACTICAL WIRELESS, I would first of all point out that, as shown in the circuit printed with my letter, there is a resistor in series with the meter movement, so the resistance of the movement itself is of little importance. It is the pronounced bend at the bottom of the resistance/voltage characteristic of a metal rectifier that use is made of and there is no time factor to enter into it since, at voltages around this bend, the resistance of the rectifier is immediately dependent upon the voltage applied. From the examples given in my letter it can easily be seen that the resistance of the rectifier must automatically be less than the combined resistance of the movement and series

(Continued on page 483)

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying commercial or surplus equipment. We cannot supply alternative details for receivers described in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. If a postal reply is required a stamped and addressed envelope must be enclosed with the coupon from page iii of cover.

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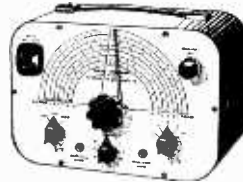
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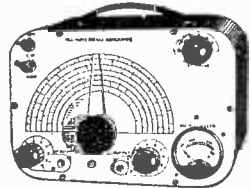


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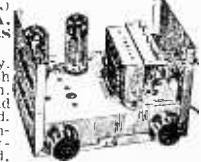
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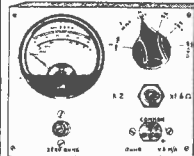


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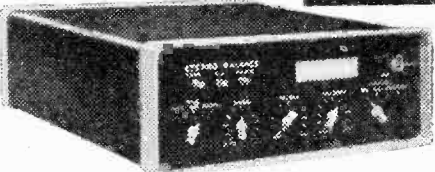
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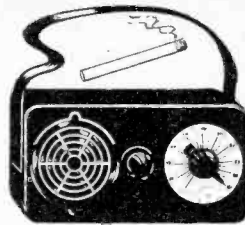
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resistor when the reading is above half-scale, the rectifier acting as a variable shunt controlled by the voltage across it.

In the circuit for testing capacitors the meter is set up to have a full-scale reading of 25 mA., and if resistors are inserted to limit the current to this, there should be no possibility of damaging the meter. I have used a 1 mA. movement set up in this way in my R/C test bridge for years. The logarithmic scale is ideal for bridge work.

Manufacturers do in fact use this form of protection. I have a letter from a British firm well known for their test instruments stating that the automatic protection now fitted to their meters "consists of an overload rectifier which is connected across the meter and this shunts the meter when excessive input is applied." They "point out, however, that it does not protect the shunt circuit but the meter only."

I agree that the cut-out fitted to the "AvoMeters" is very good, though it tends to upset the balance of the movement a bit, but I have found no difficulty in resetting it on the meters I have had.—R. V. GOODE (Tolland Bay).

An Index Suggestion

SIR.—To prevent my wife tidying away issues of this journal, so that they can never be found again, I have my annual volumes bound. I purchase the index but I do not have this bound in. I keep all the indexes in a separate folder. When I wish to search for information I can thus search all the volumes rapidly without having to keep pulling separate volumes from the shelf. Other readers may like to adopt this suggestion.—R. P. (Ipswich).

Condenser Condition Tester

SIR.—Your correspondent, Mr. Goode, in the June issue, draws attention to the protection against overload given to a meter by the use of metal rectifiers. We agree with what he says, but feel that by emphasising the logarithmic nature of the scale, he may discourage those who wish to protect their meter in a different type of instrument, the multi-range testmeter.

Rectifiers are available which will pass a negligible current when the meter is showing full-scale deflection; but which, when a large overload is applied, will pass the bulk of the excess current, leaving the meter to cope with a small overload only. A modern meter will withstand a 500 per cent. overload without flinching.

Because the current taken by the rectifier is very small when the meter shows full-scale deflection, the meter sensitivity and scale shape remain unaltered.

This system of meter protection is the only reliable one we know of which is available to the amateur.—R. MASSEY (Planet Instrument Co).

The Real Midget

SIR.—I was very interested in "The Real Midget," in the May issue of the PRACTICAL WIRELESS.

Although I will not be back in England for nearly another year, may I add my voice for a midget receiver set.

Here in Singapore the shops are full of midget receivers both American and Japanese. Most of them seem to be really good, and they are certainly small enough.

They are very popular with servicemen and their families. I get my PRACTICAL WIRELESS each month even though I'm quite a way from U.K.

I'm not building any gear myself at present because it isn't so easy to get certain components out here.—S. O. WILSON (Singapore).

Tape Heads—Data Wanted

SIR.—Many who are keen to construct tape recorders would like to know why there is such a "dog in the manger" attitude among manufacturers regarding tape heads. No advert in PRACTICAL WIRELESS has ever described or given the price of a separate tape head, nor have we ever seen details of actual circuitry and connections to pins of commercially made tape recorder heads. All that is to be seen in the adverts is the complete tape deck.—N. BENSON (Leeds).

Stereophonic Sound*

SIR.—After reading "Comments of the Month," and H.G.W.'s letter in "Open to Discussion" in July PRACTICAL WIRELESS, I feel that I cannot let this opportunity of correcting a few erroneous ideas about stereophonic sound slip by.

First of all, let me affirm that I agree entirely with H. W. Revening on all the points he raised. H.G.W. has fallen into the usual trap of comparing three-dimensional films with stereo sound. Three-dimensional films give an impression of the separation of apparent visual sources in planes perpendicular to the screen—that is some images appear farther from the screen than others. Stereo-sound separates the apparent sound sources along a line joining the two loudspeakers—that is some sounds appear to come from a point nearer one loudspeaker than the other.

As regards stereo demonstrations, after my own experiences at the Audio Fair, I am not surprised that H.G.W. noticed no difference. At each of the demonstrations I attended the loudspeakers were facing straight ahead, whereas their axes ought to have subtended an angle of 60 deg. at the listening point. Furthermore, even when the loudspeakers are correctly sited "you can't please all of the people all the time" as the man said, and unless H.G.W. was standing at the intersection of the axes, the stereo effect would not have been very noticeable.

Would it not be a good thing for all concerned if PRACTICAL WIRELESS published an article or series of articles on this most interesting subject? —Phillip Pastings (Hainault).

Correspondents Wanted

SIR.—I am 19 years of age and I am very interested in radio as a hobby and I would like to correspond with any amateurs of the same age.—R. J. R. RAYMENI, 7 Montgomery Close, Saltash, Cornwall.

* [An article on this subject appears on page 433.—Ed.]

News from the Trade

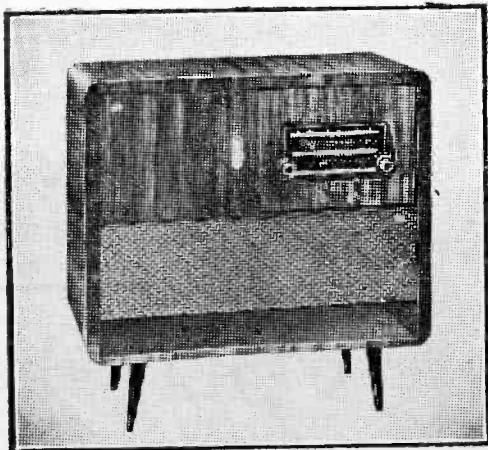
NEW PERTH SUPERGRAM

THE new Perth Supergram houses a 5-valve 3-waveband (short, medium and long) superheterodyne, with full negative feedback and automatic volume control, in a handsomely polished and fully walnut veneered cabinet.

Also incorporated is the latest 4-speed fully automatic record-changer with high fidelity crystal turn-over pick-up head for all sizes and speeds of records, and a fully matched large high flux-density loudspeaker with an exceptionally wide range of frequency response.

One of the features of the cabinet design is a shelf to accommodate periodicals and books. Price 39½ gns.

Also available is an A.F.M. model in the same



The Perth Supergram.

design of cabinet. Its chassis specification provides for: six valve, three waveband (F.M./V.H.F., medium and long) superheterodyne incorporating the finest available F.M./V.H.F. equipment, with full negative feedback and automatic volume control. An extremely wide bass/treble range tone control with an output of 4 watts ensures the highest quality reproduction under widely varied conditions.

Perth are continuing to market their popular Amplidisk automatic record player and they have introduced a set of legs in polished walnut to convert it into a handsome piece of furniture. The legs are easily removable as they are screwed in.—Perth Radios Ltd., Marten House, 39/47, East Road, London, N.1.

PRINTED CIRCUITS FOR TAPE RECORDER

THE Walter 303 is believed to be the first British tape recorder to incorporate printed circuits in its manufacture.

The printed circuit technique is used in the manufacture of this model's amplifier.

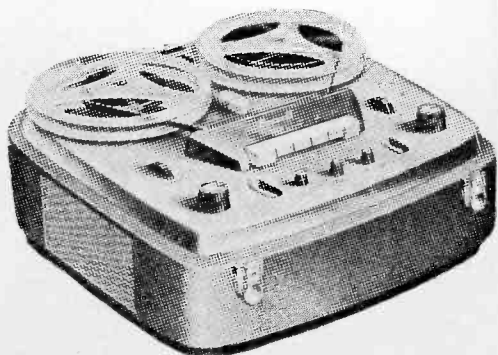
This development will aid considerably the production of the 303. It will also ensure that

the user has a machine which operates more efficiently than ever, and will be even less prone to faults.

The Walter 303 was designed, in the first place, to be a machine which could be easily operated by the general user. This new development should make it even more acceptable to the general public.—Walter Instruments Ltd., Garth Road, Morden, Surrey.

"BRENNELL" THREE STAR TAPE RECORDER

MODERN styling is the first feature to attract one's attention to this new Brennell tape recorder. Push buttons are used for mechanical operation of the three-speed deck which despite its small size accommodates reels of 7in. diameter giving a playing time, using thin tape, of six hours at the slowest speed (1½ i.p.s.). Other features are: pause control, fast wind and rewind, switched frequency correction, separate bass and treble controls, provision for external speaker (15 ohms), printed circuit amplifier. Price 58 gns.—Brennell Engineering Co., Ltd., 1a, Doughty Street, W.C.1.



The Brennell tape recorder.

STELLA PORTABLE RADIO REDUCED IN PRICE

STELLA Radio and Television Co. Ltd. announce that as a result of improved production methods the price of their portable radio receiver, Model ST 400B, has been reduced from 12½ gns. to 10 gns. The new list price is £7 11s. 7d. plus £2 18s. 5d. purchase tax.

Released in July 1957, the ST 400B is a battery-operated portable housed in a "Rexine" case—available in black or white polka dots—and fitted with an adjustable carrying strap. It weighs only 4½lb. including batteries. Four valves and a 5in. speaker are incorporated and a built-in ferroceptor gives excellent reception of stations on the long (1175-2000m) and medium (187-569m) wavebands. The set is powered by one H.T. (67.5v.) and two L.T. (1.5v.) batteries, giving approximately one hundred hours of listening.—Stella Radio & Television Co., Ltd., Oxford House, 9-15, Oxford Street, London, W.1.

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Tel.: MUS. 3451

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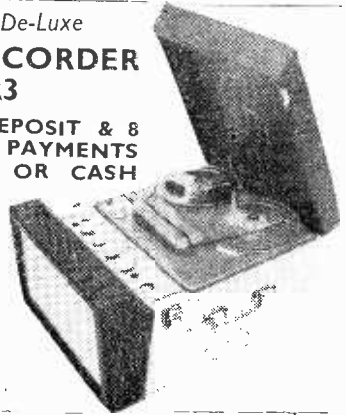
★ Instruction Book 1.6.

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"OSMOR NEWS." Information and circuit available for the following: Push-pull bias Osc. Coil. 7/6, as supplied to several tape recorder manufacturers. New Band 1/TL tunable Receptor. "R.C." 1-valve S. Waver. Transistor Regenerative Circuit. See page 416. **OSMOR RADIO PRODUCTS LTD., Stn. Croydon, Surrey.**

GUARANTEED TELEVISION, 12in. 5-Channel models. first-class picture. £26 each. carriage paid. **T.H.E. GRAMOPHONE SHOP, 19-21, Brockley Rise, London, S.E.23.**

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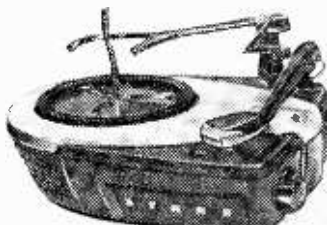
- 12in. (AIW31-74, 3 3/4, etc.)..... £5. 5.0
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6Q7G	9 6	6E58	1 6	6E58	8	6E58	6 6
6SA7M	7	6E58	1 6	6E58	4 6	6E58	9 6
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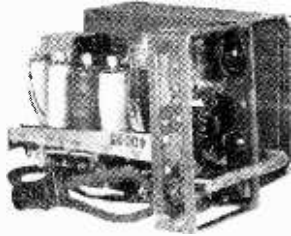
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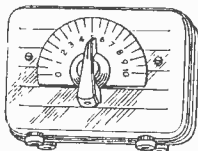
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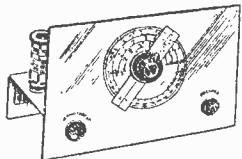
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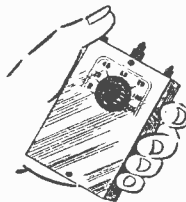
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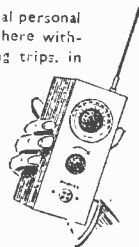
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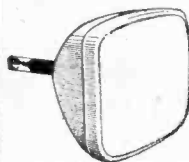
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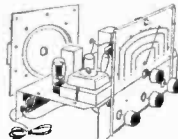
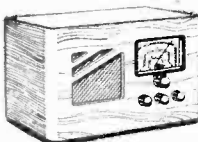
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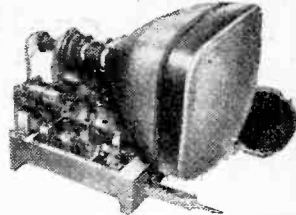
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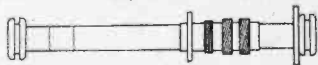
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AMATEUR WIRELESS AND WIRELESS MAGAZINE

STRAIGHT SETS

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Mains Operated

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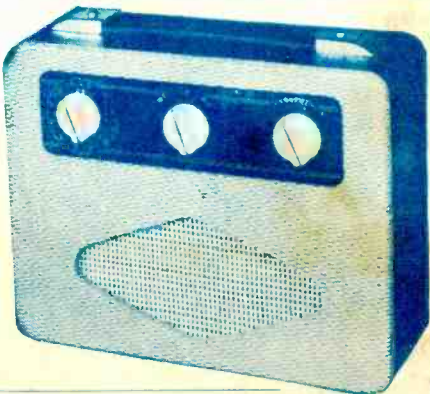
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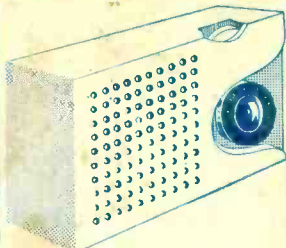
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